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SIXTH ANNUAL MEETING OF THE AMER. GAS-LIGHT ASSOCIATION.

OFFICE OF AMERICAN GAS-LIGHT ASSOCIATION,
150 BROADWAY, N. Y. CITY.

To the Gas Fraternity of America:

The many benefits ensuing to the illuminating gas manufacturers of America, from the formation of the American Gas-Light Association, have been so clearly stated by the AMERICAN GAS-LIGHT JOURNAL, in its editorial columns, that they need not be repeated at this time.

For the information of those interested in gas-making, not members of the Association, the two following sections from the Constitution are copied:

"IV. To be eligible as an active member, a person must be a President, Vice-President, Director, Secretary, Treasurer, Engineer, Consulting Engineer, or Superintendent of a Gas Company, or an Individual Manager of a Gas Works, or a Person practically skilled in the construction and management of Gas Works."

"XXVII. Active Members shall pay an initiation fee of ten dollars, and the sum of five dollars annually thereafter, which shall be paid in advance."

CHARLES NETTLETON,
Secretary.

A WORD ABOUT PATENT PROCESSES.

A penny-wise and pound-foolish process for making illuminating gas was lately introduced into one of the hotels in Brooklyn, New York, by the enterprising landlord, and the usual results will be found on another page of this issue.

We hope that the landlord, and the friends he invited to witness his pyrotechnic exhibition, have now come to the conclusion that there is nothing better nor cheaper, for illuminating purposes, than the ordinary coal gas which is made and distributed by the Brooklyn gas companies.

The use of any kind of naphtha or gasoline machine, for making or enriching gas, in cities or towns where coal gas can be obtained, should be forbidden by law.

In places where there are no regular gas works, the danger can be somewhat diminished by storing the naphtha in the ground at a distance from the building.

We should think that the makers of these kind of machines would employ men who would learn the explosive nature of naphtha, without going through the unpleasantness of an explosion to gain such knowledge; but it seems that the men who were employed in the above case were below the average in common sense. Running naphtha down through an open trough, near a lighted lamp, is about as safe as sticking a lighted candle into a barrel of powder, and watching it burn down.

As a burnt child dreads the fire, so the victim, in this case, swore he would have nothing more to do with naphtha, and ordered the whole apparatus to be taken down and carried out of the house.

ANNUAL REPORT OF THE ST. LOUIS GAS-LIGHT COMPANY.

We have just received the Second Annual Report of Mr. T. Newman, Receiver of the property of the St. Louis gas-light company, St. Louis, Mo., and have made the following extracts therefrom:

Total receipts for the year ending June 5th, 1878	$1,078,247.91
Total disbursements	979,460.31
Gas sold to private consumers	209,409,320 c.f.
" " public "	56,878,141 "
" unaccounted-for, 12·57 p. c.	38,294,539 "
Total gas manufactured	304,582,000 "
Pittsburgh coal used	56,463,160 lbs.
Cannel coal used	5,537,975 "
Total	62,001,135 lbs., or 27,679 gross tons.
Bushels of coke made	1,207,128 bush
" " used	427,825 "
Stone lime used	16,897 "
Gas purified per bushel of lime, cubic feet	18,025
Tar made	9,683 barrels.
Tar used under benches	9,243 "
Yield of gas per lb. of coal	4·91 cu. ft.
Average illuminating power of the gas at general office	14·85 candles.
Average illuminating power of gas at works	15·98 candles.
Average number of benches in action, per day	33 benches.
Total number of public lamps	3,591 lamps.
Total number of private consumers	7,397
Total length of mains laid down	118.42 miles.
Length of mains laid during the fiscal year	13·49 "
Paid for 13·49 miles of main laid	57,290 dollars.

From the preceding items, which we found scattered through the incomplete report, we have deduced the following particulars:

Average make of gas per day—834,471 cu. ft.

Average yield of gas per gross ton of coal—10,998 cubic feet.

Average yield of gas per bench per day—25,287 cubic feet.

Proportion of the gas used by private consumers	68·75	per ct.
Proportion of gas used by public	18·60	"
" " unaccounted-for	12·57	"
	100·	
Proportion of cannel coal used	8·9	per cent.
Proportion Pittsburgh coal used.	91·1	"
	100·	

Cost of mains, per mile laid, during fiscal year —$4,246.88.

Average diameter of the said mains—6·86 ins.

Average diameter of all the mains laid—4·22 inches.

Amount of gas lost per mile of main—323,381 cubic feet.

Yield of coke per gross ton of coal—43 bushels.

[This is a larger amount of coke than that generally made from one ton of the Pittsburgh and cannel mixture used.—Ed.]

Proportion of the coke used at the works—35·45 per cent.

Proportion of the tar used at the works—95·45 per cent.

If we take the candle power as taken at the general office—

The yield per pound of coal was 14·85 × 4·91 = 72·91 candle feet.

The yield per ton of coal was 72·91 × 2240 = 163,318 candle feet;

If we take the candle power as taken at the works—

The yield per pound of coal was 15·98 × 4·91 = 78·46 candle feet.

The yield per ton of coal was 78·46 × 2240 = 175,750 candle feet.

As the report does not give us the name of the cannel coal used, we cannot say whether the yields above-mentioned are good, bad or indifferent.

We believe that they generally use the Peytona and Indiana coals.

Coke Manufacture in Pennsylvania.

In a special report on coke, justly published by the board of commissioners for the second geological survey of the State of Pennsylvania, a very full account is given of the Connellsville coke trade, with much valuable information relative to the various methods of making the coke, the cost, etc.

As yet, what is known as the "Connellsville region," lying chiefly within Westmoreland and Fayette counties, Pennsylvania, is the great coke-producing district. The reasons for this are that the coal is very free from sulphur and slate, is soft and more easily mined, and can be manufactured into coke more cheaply than perhaps any coal found elsewhere. The cost of cutting this coal in 1875 was but one cent a bushel (only about 28 cents a ton), and it was, at that time, made into coke and delivered on the cars for $1.37 per net ton.

This coal bed ranges from 8 to 11 feet in thickness, and extends, almost without a fault, over a district three miles wide and 50 miles long. Previous to 1865 coke was little known or used in the country, but since that time its manufacture has enormously increased, and without doubt it is to be the fuel, at least for metallurgical purposes, in the future. From the work referred to we extract the following table, which illustrates the extent of the development up to 1875. The first column of figures represents the number of works; 2d column, number of ovens; 3d column, number of weekly shipments in cars of 600 bushels:

Fayette county branch, P. & C. R. R.	7	646	375
Southwestern Pennsylvania R. R.	9	630	374
Mount Pleasant branch P. & C. R. R.	21	1,349	860
Hickman Run branch, P. & C. R. R.	8	953	562
Total for region	45	3,578	2,171

Over 2,000 men are employed in manufacturing this coke, and it is shipped to all parts of the country, even as far west as California.

The qualities of a good coke are a bright silver color, clear metallic ring (combined with an open and porous structure) and freedom from impurities. All bituminous coals are not suitable for the manufacture of coke even when they are similar in chemical constitution to good coking coals. About the only way to determine a doubtful case is to make a practical test, which can usually be readily and cheaply done on a small scale. It has been the experience of all who have given the subject thorough and practical investigation, that a coal which does not make a good coke in a common pit or beehive oven will not yield a satisfactory product in any ovens. This, it will be understood, applies only to the physical structure of the coke and not to its composition. If the coke be poor because full of sulphur, or weak on account of the presence of slate, the trouble can be remedied by washing the coal before coking, and in all experiments tried in this vicinity so far this most important want has been satisfied.

The ovens in use generally are in the form of a beehive, being almost six feet high and twelve feet in diameter. The raw coal is thrown in through an opening in the top, and air is admitted through a door at the side, promoting sufficient combustion to drive off the hydrocarbons, and leave the fixed carbon and ash. The door at the side is gradually closed up, and finally the top is also closed and the coke left for a time, after which the door is opened and the glowing mass cooled with water from a hose. The coke is called 24-hour, or 48-hour or 72-hour, according to the time occupied in making it, the longer time producing a better and harder coke. The yield of coke is greater in bushels, though of course less in tons, than the coal used. For the beehive ovens used at Connellsville the following figures are given for each charge—

	Gross tons.
100 bushels of coal @ 76 lbs. per bushel	3·39
120 bushels of coke @ 40 lbs. per bushel	2·14
Loss by coking	1·25

Yield of coke, 63 per cent.; loss, 37 per cent. This makes the consumption one and six-tenths tons of coal to one ton of coke. The loss of carbon is about 9 per cent.

An estimate of the cost of this method of coking from actual results gave these figures—

100 bushels of coke burning cost	$1.00
Hauling and putting in oven	1.00
Drawing and loading on cars	.70
Total	$2.70

The production, from the figures given above, would be 120 bushels of coke, equal, at 40 pounds to the bushel, to 2·4 net tons. This makes the actual cost on the cars $1.15 per net ton. An analysis of this coke gives—

Water at 225 degrees	·030
Volatile matter	·460
Fixed carbon	89·576
Sulphur	·821
Ash	9·113
Total	100·000

Color of ash, reddish brown.

This analysis will be found useful for comparison, it being a fair average of the product of this district. When coal requires washing to remove slate and sulphur, a slight addition is made to the cost of the coke. Various forms of washing machines are in use. A detailed account of the method and cost of washing at the works of Messrs. Carnegie & Co., near Pittsburgh, places the cost of washing at about one-half a cent per bushel, or 12 cents per ton of 2000 lbs. The total cost of the four washers and machinery for working them was about $5000. Mr. John Fulton, M. E., in a report on the methods of coking, gives these comparative estimates of cost, assuming the raw coal to be worth $1.00 a ton at the ovens. The figures foam a most valuable basis for comparing the different methods in common use—

I.—PITS OR MOUNDS.

Hollidaysburg and Bennington, 1·67 tons coal at $1.00	$1.67
Labor, wood, etc	.70
Total cost of one gross ton of coke	$2.37

II.—BEEHIVE OVENS.

Connellsville, 1.60 tons, at $1.00	$1.60
Labor, charging and drawing	.60
Total	$2.21

BROAD TOP, KEMBLE COAL AND IRON CO.

Coal, 1.58 tons, at $1	$1.58
Labor, supplies, etc	.60
Total	$2·18

III.—BELGIAN OVENS—CAMBRIDGE IRON CO.

Hollidaysburg and Bennington, 1.42 coal, at $1.00	$1.42
Labor, supplies, etc	.45
Total	$1.87

The cost of the coal and labor of coking one gross ton of coke by the three methods just considered is as below—

I. Pits or mounds, $2.37.
II. Beehive ovens, $2.20.
III. Belgian ovens, $1.87.

This comparison takes no account of interest on the investment required by the different methods. Allowing for this at 10 per cent, Mr. Fulton makes this comparison—

1. Mounds or pits, $2.37 3-5.
II. Beehive ovens, $2.33 3-6.
III. Belgian ovens, $2.06¾.

The estimated cost of the plant for the production of 100 tons of coke per day (exclusive of trucks, cars, etc.), is—

I. Pits or mounds, $1,000.
II. 80 beehive ovens, $32,000.
III. 65 Belgian ovens (including engine), $55,300.

These figures, while correct for the examples given, do not imply that the Belgian ovens are always the most desirable, because it is necessary to adapt the oven to the peculiar treatment required by each coal, and that is a matter not easily determined except by experiment.—*Saward's Coal Trade Journal.*

A Large Quartz Mine.—A mammoth quartz mill is soon to be shipped from California to the the Father De Smet mine in the Black Hills. A contract has been made with the Union Pacific for 60 cars to transport the machinery. The mill building is to be 120 feet long, 100 feet wide, and 40 feet high to the eaves. This company has ordered three miles of iron pipe from Chicago, which will fill 20 cars, and this is merely for the canons across which the supply ditch is to pass. Over $200,000 will be expended in the 36 miles of this ditch from Spearfish Creek to the De Smet mill. The mine cost $400,000, and the mill to be put up is said to be the largest one that ever went into a mine.—*Iron Age.*

The Smith & Farmer Duplex Center Seal.

The accompanying engraving represents an improved Dry Center Seal, which was designed for the purpose of increasing the capacity of the purifying house, and also for more thoroughly utilizing the lime or other purifying material used.

In the construction of this center seal, the inventors have placed a simple bye-pass valve on the top of the ordinary dry center seal, and connected them in such a manner that the gas may be turned in any direction required to make the various changes enumerated below.

This new invention might with propriety be called the universal center seal; since, by its use alone, more changes can be made than by the ordinary center seal, and several bye-passes combined.

With a system of four purifiers, the following changes can be made, viz.:

1. One of the boxes can be thrown into action alone, and the remainder thrown out if required.
2. Two of the boxes can be thrown into action alone, and the remainder thrown out.
3. Three of the boxes can be thrown into action alone and the other thrown out.
4. Four of the boxes can be thrown into action.

The first-named facility will enable the engineer to take and keep off any of the boxes and connections which he may desire to repair or alter.

The second facility will enable him to put two of the boxes into action, and throw off two for cleaning, etc.

The third facility will enable him to work the boxes in the ordinary manner—viz., three boxes always on and one box always off.

The fourth facility will enable him to throw every box in the system into action, and increase the capacity of the purifying house fully 25 per cent.; because every box will be in action; the foulest will be kept much longer than that in the ordinary system, and, consequently the lime will be more thoroughly utilized.

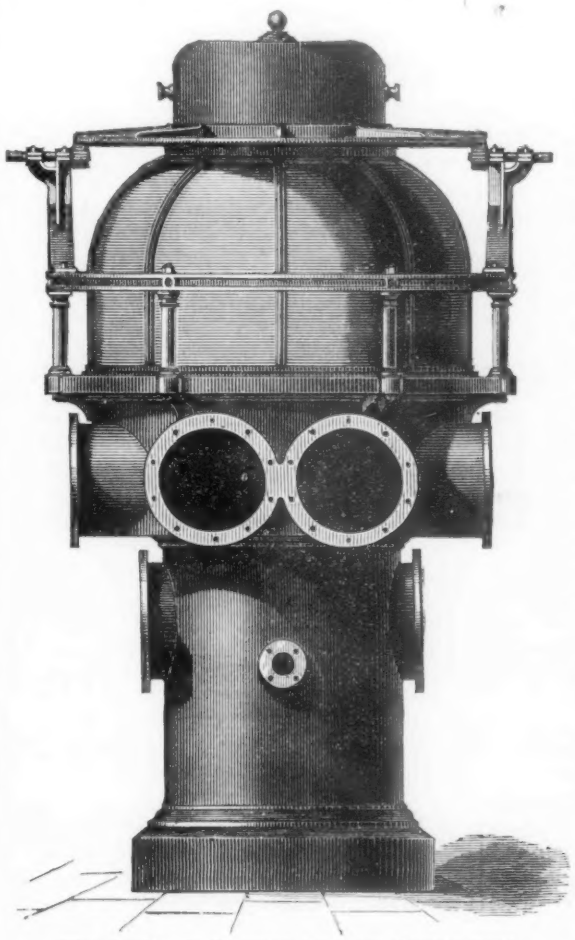
It has often been claimed that 25 or 30 per cent. of the lime used in the ordinary purifiers has to be thrown out, before it can be thoroughly utilised, because it cannot be kept in contact with the gas long enough.

About twenty-eight different changes or combinations can be made with this center seal, where there are four purifying boxes in the system; and a great many more can be made where there are 6 or 8 or more boxes in the system.

All the improvements secured by this invention can be applied to the old style of dry center seal, by merely substituting a new cover for the old one—as there is not any change made in the body.

The principle can also be applied to the wet center seal, if required.

Two of these center seals, for twenty-inch connections, are now being erected at the Manhattan gas works, New York.



The Smith & Farmer Duplex Center Seal.

Notes on Some Points in Boiler Making.

By Robert Briggs, C. E.

The recent inspection, by the writer, of a proposed standard drawing of a common external fired tubular boiler, such as now has so general usage in this country, brought to notice two errors of construction in general, almost universal, practice, which it may be of some avail to discuss. In the example referred to, there was shown a flat-headed steam dome, with stays to strengthen it, running down to the sides of the dome diagonally. The steam pipe was taken off from the middle of this flat dome sheet. Now it may be admitted that the staying of sheet, which was three feet in diameter, was ample for the pressure proposed to be carried, so that the conditions for *use* of the boiler were abundantly fulfilled; but it is contended that equal strength could have been had by giving the proper form to the head sheet without staying at all. Thus it is perfectly well known that the strength of a spherical shell, or of any portion of a sperical shell, is twice as great as that of the shell of a cylinder of the same diameter, when both shell and cylinder have the same thickness; or, on the other hand, that a spherical shell, or part of a spherical shell, possesses the same strength as a cylindric shell of the same thickness, when the radius of the spherical surface is equal to the diameter of the cylindric one. In this last case, when the rule stated is applied to the head of the dome or end of the boiler, which is *formed* to a part of a spherical surface whose radius is the diameter of the dome or boiler, the head or end is "dished" out 0.134 time the diameter of the head or end. A three-foot head requires to be *dished* only 0·4 of a foot (about 4 13 16 inches) in order to give the same strength to resist internal pressure, for both head and shell, of the same thickness of iron. A little allowance is needed for the thinning of the sheet iron in *dishing* in such case, as it may be thought proper that the thickness be preserved to the equality with that of the shell. This allowance is easily computed. The surface of the flat circular plate is, to that of the dished plate, as 1 to 1·072. That is, the thickness of the circle, before dishing, should be about 7 per cent. greater than that of the iron of the shell. This extra thickness, however, is a refinement of the boiler-maker or user, who would sell or buy the cheapest boiler consistent with full requirements for strength; as the flanging of the head will inevitably upset the flange itself to a thickness much above the original one, so that a dished head, as above described, of iron of ordinary shell thickness, will be much stronger than the shell sheets at the joints, where they are weakened by the rivet holes, even with the double-riveted longitudinal seams.

These considerations apply more particularly to boiler-making in America, where it would be difficult to procure iron so poor that it would not dish readily without impairment of strength, such iron being capable of flanging at any heat; yet the same reasoning applies to English boiler work; although the frequent use of egg-end boilers seems to indicate that the argument here advanced has not been entertained or appreciated. In this country, certainly, it is pure waste of money to make a flat stayed head, when a dished one will answer.

The next point to be noticed is the use of cast iron bonnet manhole rings on the cylindric portion of a boiler when a manhole is wanted on such a surface. First, within some reasonable limit of curvature, it can be affirmed that a bent manhole is just as good for service as a flat one. For shells of 3½ feet in diameter and above, this is absolutely true. Double clips are always better than one; but with one clip, it is practicable to make as good a joint as any steam engineer may desire with such bent manholes, and a rubber, or, what I prefer, a hemp-plait gasket filled with red and white lead (with a little litharge if in a hurry). Secondly, for all places, both curved and flat, a wrought iron manhole ring is better than a cast iron one. It is safer, easier to make up to the boiler, and when the difference of weight is considered, it is nearly, if not quite, as cheap as a cast iron ring piece. Care should be taken to make the wrought iron rings heavy enough. Most of the failures to use them have been occasioned by *saving* in material; but material enough to give strength to the boiler, where it has been weakened by the manhole, is ample for all purposes, and the dimensions to supply this strength are easily computed. Suppose the manhole be 10×14, and imagine a shell 7-16 thick. The weak place of such a hole is the 14-inch way, if it is longitudinal to the cylinder. There have then been removed from the shell $14 \times 7\text{-}16$ or $6\frac{1}{4}$ square inches of material, whence, for bare strength only 3 7-16 square inches of iron should be found at each end of the manhole. $2\frac{1}{2} \times 1\frac{1}{4}$ give $3\frac{1}{4}$ square inches of section, and adding to the width $\frac{3}{4}$ for the rivet holes in the ring, becomes $3\frac{1}{4} \times 1\frac{1}{4}$. This dimension is the least that should be used in this case, and it will be found ample for the jointing of the manhole plate. Little deduction should be made in case the hole is made transverse to the shell. Here the curvature of the shell begins to tell on the strength of the ring, and in such case double clips should be used for the plate.

Wrought iron manhole rings should always be riveted to the inside of the boiler.

If a cast iron bonnet, manhole ring, or flange boss, is to be riveted to a boiler, it is very desirable to have heavy flanges; quite twice as heavy as usual for flange joints with bolts, and then it

is advisable to rivet a thin plate one-eighth or three-sixteenths thick between the casting and the shell of the boiler, so as to form a calking strip to drive against; but in these days of cheap wrought iron, cast iron attachments to boilers, either nozzles, bonnets or rings, have become almost inexcusable cheapenings. Boiler-makers will also find out, at some time, that wrought iron flue doors, and ash-pit doors, properly made on formers, are handsomer, more durable, and nearly as cheap, as the ponderous castings which have heretofore disfigured fire fronts.—*Jour. Franklin Inst.*

On the Arrangement and Construction of Gas Works.

By Mr. H. Ellis Hill, A.I.C.E.

[A Paper read before the Civil and Mechanical Engineers Society, on Thursday, April 11, 1878.]

Mr. President and Gentlemen—The subject of gas making and supply is so large and important that I have thought it best in this paper to treat in general terms of the arrangement and construction of gas works, by way of introduction, to be followed, I hope, in future sessions, by papers from other members on the various special apparatus.

The use of coal gas for lighting and heating purposes, although now so general, is of comparatively recent growth, at the beginning of the present century being scarcely known; the wise men of that day prophesying not only its speedy departure, but also that terrible disasters would occur while it was in use; while a clever Member of Parliament said it would be an impossibility to get a light without a wick. Since then ideas have entirely changed, and now gas light has become nearly universal, many millions sterling being employed in gas works, giving occupation to thousands of men, and taxing the abilities and energies of many of our best-known engineers.

The first consideration in connection with the design of a gas works is, of course, obtaining a suitable area and site; and this is of the utmost importance, not only as bearing on the first cost of the works, but, also—and this is, perhaps, of still more importance—on the working expenses for manufacture, so long as the works may be in existence.

Having estimated, then, the requirements of the district, and the capacity of the works, not only to supply present needs, but also the probable quantity required within, say, the next ten years, an area should then be obtained large enough to contain the works and also to allow for the probable extension, so that new buildings and apparatus may be conveniently added as required. This area should be easy of access by rail, and, also, if possible, by water. A railway siding should run into the works, so that coal could be delivered directly into the coal store, and empty trucks returned to the line with the minimum amount of labor. The works should also—and this would generally follow if near a river—be at a low level compared with the district to be supplied. Sometimes great difficulty is experienced, if part of the town is higher and part lower than the works, in keeping a uniform and constant supply to both parts. Gas, having a natural tendency to rise, would supply the higher levels; but the lower parts, unless supplied from a different holder, and under pressure, would often be without any. But, while it is of advantage to obtain a low level for the works, care must be taken that the district is not likely to be inundated by floods, as was the case at some large works I recently visited, where the utmost difficulty was experienced in keeping the flood waters from the retort furnaces.

The site having been decided upon, the all-important question of arrangement would then require that all the knowledge and ingenuity of the engineer should be brought to its proper consideration. All the apparatus should be constructed and arranged so that the coal may be easily received in the stores, and then passed on from stage to stage until the purified gas is safely stored in the holder ready for distribution into the town mains.

Now, Mr. President, having briefly introduced the subject, it will probably be more convenient to the members, for the purposes of discussion, if instead of laying down abstract principles and general formulæ, I put before you model works I have designed for a town of a given size, and work out and describe the apparatus in the order of its procedure when gas-making, pretty much in the same way an engineer would have to do if called upon to design such works.

First in order and importance, as regulating the size of the whole works, is the retort-house and fittings. I have taken, in this instance, a town of 5,000 inhabitants, and have designed the works to be fully equal to their present demands, and with space for easy extension to twice that capacity.

For small works of this size the retorts would be what are called single settings—that is, open at one end only, the benches being about 10 feet in length from front to back, and the retorts 16 inches in diameter. The house should be 30 feet clear span, and about 20 feet high to the wall plate, covered with a slated roof on wrought-iron trussed principals, and well furnished with louvre openings for ventilation, the length of the house being regulated by the number and size of the retort benches. A space in front of the retorts, about 8 feet in width and the whole length of the benches, should be paved with fire bricks on edge, laid with a gentle slope towards the furnace, so that the water used in slaking coke may run into the ash pit, the remainder of the house being paved with 4-inch flagging. The retorts may be either round, oval, or D-shape; the two latter give the best carbonizing results, but are not so strong as the round; so that in small works where there would not be many spare benches, the round ones would generally be preferred. The number of retorts required would be found by the following rule:

For a small town a fair allowance would be 1800 cubic feet of gas per head of population (so that for 5000 people 9 million cubic feet of gas) per annum. This, divided by 180 days—a number found to give a good practical result—shows 50,000 cubic feet as the average daily consumption; but as the heaviest day's make must be allowed for, this would probably be half as much again, or 75,000 cubic feet. Each retort would produce about 4,600 cubic feet of gas per day of 24 hours. Thus 17 retorts would be required for the heaviest day's make. Add to this number 25 per cent. for repairs; the retort-house should, therefore, be constructed for 21 or 22 retorts. Supposing a bench to be set with seven retorts—a very good number—three benches would be required, or, perhaps, a preferable arrangement would be as shown on the plan—that is, two benches of sevens, one of five, and a smaller one of three retorts, thus giving increased facilities for regulating the make between the small consumption of midsummer and the heaviest winter's day, as a combination of either 3, 5, 7, 8, 10, 12, 14, 15, 17, 19, or 22 retorts may be used. The retorts are charged by means of a long scoop, with about two cwt. of coal, and allowed to carbonize between four and five hours—a good method being to give five charges per 24 hours. The gas, as made, is taken from the retorts by an ascension-pipe above the projecting mouthpiece, generally five inches internal diameter at the lower end, and tapering to four inches internal diameter at the top. The gas then passes at a considerable distance above the retorts through a cross, or H-pipe, and hydraulic dip, into the hydraulic main—a simple and beautiful contrivance for carrying off the gas. The main should be made, for lightness and strength, of wrought iron plates, bent to the required shape—generally U section—having a flat cover, with opening to admit the dip-pipes. The main is generally carried by brickwork or brackets from the top of the benches. The lower portion of the hydraulic main is charged with tar and liquor at a sufficient height to immerse the lower end of the dip-pipe, and form a seal, so that the gas which forces its way, or is drawn, from the retorts cannot return. In some cases the hydraulic main is constructed in short lengths or sections, the gas and tar being taken off by a false main running parallel to it.

The retort benches are constructed principally of fire-bricks, having a furnace below, with openings or flues passing round the retorts for the heated gases from the furnace to carbonize the coal in the retorts—a single flue passing from the end to the main chimney stack. Through bolts are built into or over the stack, to prevent it splitting with the varying temperatures. Before re-charging the retorts, the residual coke is drawn out and slaked, part being used as fuel in the furnace, and the remainder stacked in a convenient place for sale.

In connection with this part of the works should be built the coal stores. The preferable way is to put the building parallel to the retort-house, and opposite the front of the retorts. The size would, of course, vary with the facilities for obtaining coal supply; but, in ordinary cases, a storage capacity equal to six weeks heavy consumption should be allowed for. The building should be so arranged that the full coal trucks from the railway could run in and drop their contents on to the floor of the stores, until the coal reached the level of the rails. It could then be thrown over the sides of the trucks on each side, and walled up to the level of the wall-plates. The lower part of the wall, between the stores and retort-house, should have openings through which coals could be drawn for use in charging the retorts. The building in the design has been shown 22 feet clear span, and the same height and length as the retort-house. The rails for the trucks would be carried on columns and girders for the length of the building, the top of the rails being 12 feet from the ground level, to allow loaded trucks passing under the tie-rods of the roof. The calculations for size of stores are very simple. Taking 75,000 cubic feet as the heaviest day's make, and a ton of coal as yielding 9500 cubic feet of gas, a day's consumption would be 7·9 tons by 42 days, equal 332 tons, at 43 cubic feet per ton, equals 14,276 cubic feet of space required for storage of coal. By having a large coal store the works would not only be independent of fluctuations in the supply, but the coal would get thoroughly dry before being required for use.

The coal having been brought from the railway to the stores, and thence to the retorts, the products of carbonization—that is, the illuminating gas and its impurities, and the condensed tar and liquor—pass from the retorts through the hydraulic main to the condenser to be gradually cooled

down to as nearly as possible the atmospheric temperature.

Condensers are of various designs ; those known as surface condensers are the most general and the simplest in their action. These are of three well-known types ; that is—

1. The series of horizontal, or nearly horizontal tubes, the lower ones immersed in water, in which the gas passes backwards and forwards from the top to the bottom, being gradually cooled in its passage by radiation through the metal of the tubes.

2. The vertical pipes, fixed on a rectangular iron box, in which the gas passes alternately up and down through the series, until the temperature is sufficiently lowered ; but perhaps the simplest and best form is the vertical annular condenser, consisting of a series of double tubes, side by side, with annular spaces between them. These tubes are fixed at the lower ends on to a rectangular box by short horizontal branch pipes to the top, or by diagonal pipes from top to bottom. The gas from the hydraulic mains, passing into the annular space at one end of the condenser, is brought in contact with two cool surfaces —that is, the outer and inner tube, exposed to the atmosphere. As the gas cools, the tar and liquor carried with it are deposited, and trickle down the sides and into the chamber beneath, and from thence to the tar-well, the series of tubes being sufficiently large to give the required amount of cooling surface. The advantage of this condenser is that a continuous current of air is kept up through the inner tube, caused by the cold exterior air forcing upwards the warmer air from inside the tube. In warm weather, if the condenser is exposed to the direct action of the sun, water may be allowed to play on the outside tube, to keep it cool ; and in cold weather the inner tube may be closed, or partially closed, to regulate the supply of cold air. In calculating the size of condensers, it is usual to allow 150 superficial feet of cooling surface for each 1000 cubic feet of gas passed through per hour ; so, for works of the size illustrated, that is 75,000 cubic feet for the heaviest day's make, or 3125 cubic feet per hour, a condenser with 470 superficial feet of cooling surface would be required, or say two condensers, each 2 feet 6 inches outside diameter by 18 feet high.

The next apparatus in order is the exhauster, for drawing the gas from the condenser and passing it on to the scrubber, for lessening the pressure, and for preventing the deposition of carbon in the retorts. There are two distinct types of exhausters in general use, the rotatory and reciprocating, each having advocates, the former, I believe, giving generally the better results. The rotatory exhauster consists of two cylinders, the outer one fixed to a bed plate, and having within it a smaller one revolving on a shaft set out of centre. Projecting from the smaller cylinder is a slide actuated by a pin working in a groove in the outer casing. As the inner cylinder revolves, the slide filling the space between it and the casing causes a vacuum behind, into which rushes the gas from the condenser, and at the same time the gas in front of the slide is forced on to the scrubber ; the theoretical objection to this form being that they do not exhaust steadily, as the work done in similar times varies with the varying length of the diaphragm slide between the two cylinders. The reciprocating exhauster is similar in principle to a horizontal blowing engine, the piston of the exhausting cylinder being worked either direct from the end of the steam piston-rod, or by a connecting-rod from the crank-shaft ; the action being, of course, the reverse of that in the steam cylinder—that is, the piston causes in its travel a vacuum behind it, and the gas from the condenser rushes in, and at the return stroke is forced through what would be called the exhaust port of a steam cylinder on to the scrubber. In single exhausters of this type, the same objection would apply as to the rotatory type, but they are generally made with two exhausting cylinders, the pistons being driven by cranks set at right angles, so as to equalize the work done as nearly as possible to the traverse of the steam piston.

From the exhauster the gas is passed to the scrubber, to remove the ammonia. The scrubber, as generally constructed, consists of a large upright cylinder with an inlet pipe at the bottom and an outlet at the top. Shelves are arranged inside, covered with coke, tiles, brushwood, or other porous substance ; or, as is probably the best plan, filled with thin boards set on edge and crossed in layers, the boards being about three-eighths of an inch thick, with about the same amount of space between. At the top of the scrubber is an apparatus for distributing water or ammoniacal water over the surface. This water or liquor, trickling down through the pores or spaces of the materials, absorbs the ammonia from the ascending gas. When coke is used it must be periodically renewed, as the pores become choked with impurities ; but as far as I know this does not seem necessary with the boards, some scrubbers having been in work some years without requiring any change of filling. This stage of gas purification has become more important during the last few years, because not only is an impurity taken from the gas, but a valuable article of commerce is obtained. A scrubber requires a capacity of 150 cubic feet for each 1000 cubic feet of gas passed per hour, and 15 gallons of water per ton of coal carbonized. So for works of the size now described the scrubber should be six feet in diameter and eighteen feet high.

In connection with the scrubber and condenser is a tar and liquor tank, into which the tar and liquor, distilled from the gas in the condenser and scrubber, pass for storage until sold. The tank, or well, may be of brickwork, concrete, or iron, sunk in the ground, the top being level with the surface. The size should be equal to eight weeks storage, taking 25 gallons as the quantity yielded by each ton of coal carbonized. The size shown on the plan is 20 feet by 15 feet by 12 feet deep.

Following the scrubber are the purifiers, where the gas is completely purified before entering the holder. They are generally arranged in sets of four—three being in use and one at liberty for recharging—a centre-valve being placed between them to direct the passage of gas in any required order through the purifiers. The usual pattern of purifier is like a large box, constructed with cast-iron ribbed plates, bolted together and caulked at the flanges. Ledges are cast inside, on which rest wood sieves, covered with lime or oxide of iron. In the Metropolitan district, where the Act of Parliament is very strict as to the appearance of carbonic acid, lime is necessarily used in purifiers, either wholly or in conjunction with oxide ; but in the provinces oxide is very often the only material used. The cover of the purifier, which is removable, is made to pass over the sides, dipping into a recess nearly filled with water, acting as a seal to prevent the escape of gas. The gas from the scrubber is introduced at the bottom of the purifier, and, in passing through the purifying agent, parts with its carbonic acid and sulphuretted hydrogen, the process of purification being similar, whether the agent employed be lime, oxide, or a combination of the two. Taking, for example, a set of lime purifiers, in each casing would be an arrangement of sieves—generally four or five placed one above the other—each spread with a layer of slaked lime 3 or 4 inches in thickness. The gas entering from an inlet-pipe at the bottom, passes through each layer and down an outlet-pipe at the top, leaving a portion of its carbonic acid and sulphuretted hydrogen in combination with the lime. The gas then passes through the centre-valve to the second purifier, and then to the third, by which time it should have obtained the required state of purity. When the first purifier has become too foul for further use, the valve cover is lifted and turned a quarter turn, the second purifier then becomes the first in order, and the spare one, which had in the meantime been refilled, brought into use, as the third one—the one that has now been thrown out of action—is emptied of its foul contents ready for recharging when required. When oxide is used, the sieves would be less in number, and have thicker layers. The great difference between the two systems is not so much in the action as in the residue, which, in the case of lime, becomes an intolereble nuisance while it remains in the works ; and, although it is possible in country districts to sell it as manure, in large towns it is often difficult to get rid of it even by payment ; while in the case of oxide, the spent material may be laid on the ground, and after turning over for two or three days is again fit for use. Before emptying a purifier, the cover has to be lifted and taken away. A very usual plan of doing this is to have rails supported on brackets running along the length of the house over the purifiers. On these rails is a traveller-frame with a traversing hand-crab, or with a vertical screw, to which are slung four chains hooked into shackles at the corners of the cover, by which the cover may be lifted and carried over the next purifier. This method is only applicable where the weight of the cover is not so great : but in large works where manual labor, both in lifting the covers and filling the purifiers, must be as much as possible dispensed with, different systems have been adopted. The latest and most complete arrangement of the kind for this purpose, and of which, by the kindness of my friend, Mr. Morley, of the Salford Corporation gas works, who has also supplied me with much other valuable information on the subject of this paper, I am able to give particulars, is now being applied to some new purifiers, 30 feet square, at those works. In this a line shaft runs along two sides and one end of the purifier-house, driven by a belt from an engine below, the lifting machinery for each purifier consisting of four square thread screws, one at each corner, working in worm wheel nuts, attached to the beams carrying the purifiers. These wheels are actuated by worms on shafts alongside the purifier, the four shafts being connected at the corners by mitre gearing, so that when set in motion the four screws are simultaneously turned, and the cover raised to the required height. When high enough, four carrier wheels are inserted into brackets on the cover, the screws are withdrawn, and the cover, running on wheels, is hauled along on the edge of the purifier on to the next one, a short rail being placed between them to make a continuous line. In connection with this apparatus is an arrangement for lifting the oxide and recharging the purifiers. Between each pair of purifiers is an elevator consisting of a series of iron buckets on links, forming a continuous chain, carried round a drum at the top of the house, the lower end dipping into an elevator trough on the ground floor, into which oxide is tipped from barrows. When a purifier requires charging, the el-

evator is put into motion by worm-wheel gearing, and takes up from the oxide trough a continuous supply, delivering it into a hopper attached to a swinging shoot, so arranged that it may be brought over the centre of the purifier being charged, the attendant merely having to spread it evenly upon the surface. The whole of the machinery for lifting the covers and filling the purifiers is to be driven by an engine with a 10½ inches diameter of cylinder, and 24 inches stroke. The boiler will be five feet six inches diameter, 15 feet long, with two feet nine inches tube. To calculate the size of purifiers, the simplest rule is, supposing there to be four to the set, three always in work—multiply the heaviest days' make in thousands by ·6, for the superficial area of each purifier.

From the puriffer the gas passes through an instrument which, although having nothing to do with either the manufacture, purification, or storage, is an essential part of all well-regulated gas-works—that is, the station-meter for measuring and registering the quantity of gas made. Its construction is similar to an ordinary service-meter, but, of course, large enough to pass the total make of the works.

The gas now being made, purified, and measured has to be stored previous to distribution to the town. For this purpose a gasholder and tank are required.

The tank is generally a large circular pit, sunk in the ground, and lined with brickwork backed with clay puddle, finishing at the ground level with a stone coping. Until recently, except where iron tanks were used, brickwork was the only material used for tanks. But a few years since, Mr. Livesey, of the South Metropolitan works, who has had the honor of introducing many improvements into gas-works, constructed a concrete tank with a brick lining, and afterwards one entirely of concrete, and without any puddle backing, and with so much success that, I believe, concrete is destined, from its adaptability and cheapness, to supersede brick for this work. At one side of the tank is a recess to receive the inlet-pipe from the station-meter and the outlet-pipe to the street mains. Bed stones are placed on the bottom of the tank to receive the runner guides for the holder, and at the coping for the columns or stanchions.

The general appearance of a gasholder is so well known as to need no description here. Its construction is, however, a matter of great importance, being a costly article, and requiring more skill to construct and erect than any other portion of gas-works plant. There are two kinds of holders—the single and the telescopic—the former cheaper as to first cost, but the latter, by taking up less ground, would probably be found cheaper in the end.

The holder shown on the plan is 54 feet in diameter, double lift, each 17 feet 6 inches high, the plates varying in thickness, according to position; the crown plate being three-eighths of an inch thick, the inner and outer circles No. 13 Birmingham wire gauge, the remainder of the roof sheets No. 14 B. W. G., the top and bottom tiers of the sides No. 14 B. W. G., the others No. 15; rivets for the thin plates quarter of an inch diameter, 1 inch pitch. At the bottom of the inner lift is a cup to receive the dip of the outer lift; the cup and dip are similar in construction, but inverted in position, and may be made by rivetting to the shell of the holder, and to a vertical plate, a piece of channel iron or double angle iron, or a plate may be bent to the required form. When in action the cup would be partially filled with water to act as a seal, to prevent the escape of gas between the lifts; the sides of the holder are generally stiffened by vertical truss bars to prevent the sides buckling when resting on the bottom of the tank; the cover is also, in most cases, trussed for the alleged purpose of keeping the crown in its proper shape when not distended by gas. This point, however, is now being warmly discussed, the result of which will, I think, be that trussed covers will soon belong only to the past; for it seems contrary to all ideas of correct designing that a heavy trussing should be attached to and carried up and down with the cover in all its journeying, and continually straining it merely because it may be wanted to keep the cover in shape when the holder is empty, which could be more simply and effectually done by erecting a fixed light in the tank to receive the cover. The holder is kept in a vertical position by guide pulleys running on guide-bars in the tank, and continued up the face of the columns.

For economical working, and for the peace of mind of the manager, the holder should be large enough to contain 24 hours maximum make, and furnished with, say, one column to every 10 feet diameter of holder.

There is nothing very special about the ordinary column, except that it is specially unadapted for the work it has to do, and will possibly, in the future, give place to the light but stiff wrought-iron lattice columns now largely used in America.

From the holder the gas is taken by an outlet-main through the governor—an apparatus for regulating the pressure—into the town mains and service-pipes, for use as required.

Within the boundary of the works there should of course be a manager's house, and the necessary offices, stores, fitting-shop, etc.

I have made no particular mention of the arrangement of bye-passes, by which, on opening and closing different valves, the gas may be made to pass by, instead of through, any apparatus which may be temporarily disabled.

[Correspondence *London Journal of Gas-Lighting*, June 11th, 1878.]

The Removal of Sulphur Compounds.

Sir—Some few weeks since I stated the fact of my being in the habit of distilling ammonia into the hydraulic main of our works. Will you kindly allow me to state that I do not find it necessary to coat the ascension pipes with non-conducting material, to raise the temperature of the gas in the hydraulic main; but I combine steam with the distilled ammonia, and send it into the hydranlic mains at the extreme ends; and, as this heated ammonia and steam have to pass each dip-pipe, from which the crude gas is escaping, they mix freely together, and flow on to the outlet, and enter the horizontal condensing main with the tar and liquor. In this way I can readily raise the temperature of the gases in their crude state. I have, of course, provided suitable apparatus to rrgulate the temperature of the steam, etc., entering the hydraulic main.

As it would not be desirable to convert the tar into pitch at that point, at a spot in the horizontal condensing main where the temperature is about 120° Fahr., I drop the tar and liquor through a dip-pipe into a strong wrought-iron air tight tank, having a vent into an air-tight tar-well. In this tank the tar settles away from the liquor, and can be readily drawn off into barrels, etc., for the market. The clear liquor is very strong in ammonia; and, as it contains very little carbonic acid, I have provided special means to regulate its temperature, and to pump it direct into what I term a scrubber-washer—an apparatus specially designed to break up the cold gas into the thinnest possible streams, and bring it into close contact with the strong ammonia which I cause to pass through it.

I do not wash my gas with liquid ammonia on the outlet of the hydraulic main, as was shown the other day in the description you gave of my apparatus in the *Journal*, because I found, when I made my experiments some time since, that a large quantity of thin oily tar was deposited, and the general effect on the gas was not so good as we desired, besides making an extra pull of three inches for the exhauster, and an unsteady gauge on the hydraulic.

I then constructed a kind of brush arrangement composed of a great number of small wires suspended with their points in water. As the water line could be regulated in this vessel at pleasure, I could easily increase or decrease the speed of the gases and vapors through the wires or spaces. This worked very well for two seasons, and gave excellent results in breaking up the gas and assisting to deposit condensable matters from the gas. Since then I have made what I consider a better and more powerful arrangement, and it is giving good results without any additional strain to the exhauster.

I will not trespass further on your valuable space; but, at some future convenient time, with your kind permission, shall be prepared to give some few practical hints, not only upon the purification of gas by ammonia, but also upon the successful recovery of sulphur and ammonia, and the conversion of the same into sulphate of ammonia.

JOHN HAMMOND.

Lewes, June 1, 1878.

Some Important Facts Concerning the Gas Question in Paterson.

[The following correspondence, clipped from the Paterson *Daily Press*, of July 25th, will be of interest to our readers.]

To the Editor of the Press:

Dear Sir: The commissioners to receive subscriptions to the capital stock of the Citizens gas light company, will meet to-day for that purpose. As an inducement to our citizens to subscribe for the stock, it is said that the new company will make gas from water and petroleum by the "Lowe" process, and that therefore they can supply the gas at lower rates than is charged by the Paterson gas-light company, and pay dividends on its stock.

Before investing money in the stock, or lending its influence to the new company, the public should be put in possession of a few facts that within a few days have come to the knowledge of the writer regarding the "Lowe" process.

The Harrisburgh "Lowe" gas works, another company reported on by the Board of Trade Committee, has failed, and is advertised for sale by the sheriff.

The Manayunk works (same process) were operated for two years, and then given up for coal gas, as unprofitable.

The Trenton gas company bought the Lowe works and have been running them to see if there is any advantage in the process. They find after a year's careful accounting that the gas costs more than coal gas and does not give satisfaction to the consumers.

Judging from these experiments if the Citizens gas company expect to made good gas from air or water by some of the patent processes (and there are many of them) their stockholders will not get much in dividends, and the public will be disappointed in the quality and price of the gas. If then, there is no better or cheaper way of making gas than that used by the present company where is the necessity of starting another? The old company has all the facilities for supplying a city twice as large as ours, could do so without comparatively any increase in cost and at a great reduction to the consumer in the price of gas.

But let another company come in here with its additional capital to be supported, and the price of gas will go up in proportion. Competition may at first bring the price down, but in the end there will be a combination and a putting up of the price.

The directors of the Paterson gas-light company have already largely reduced the price of gas, and expect to make further reduction, but they must protect the property of the stockholders. Our sensible business men understand this and do not complain.

There are some persons who think that they should get it at about the cost of oil, forgetting that the convenience and safety of gas cannot be had without a large expense. There are a few with charters for sale, some with patents to sell, others with very eligible sites for gas works for sale. If these were once provided for the public would not hear much about the high price of gas for some time to come.

J. C.

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FRIDAY, AUGUST 16, 1878.

Official Report of Examinations of Gas for two Weeks ending Aug. 10, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

July 1788.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
28		16.76	16.62	19.28	17.61	16.92	
29	Between 6 A. M.	16.28	15.94	20.75	17.67	16.46	
30	and	15.83	17.01	21.85	17.27	16.11	
31		16.83	16.11	21.65	17.81	16.87	
Aug. 1	9.30 A. M.	16.68	16.54	19.64	17.57	16.50	
2		16.36	16.36	20.87	17.60	16.09	
3	Average	16.45	16.43	20.67	17.59	16.49	
		16.00	16.73	21.68	16.67	16.46	
5		15.65	15.77	20.73	17.32	15.89	
6		16.08	16.71	21.07	17.48	17.36	
7		16.31	16.64	20.83	17.01	16.07	
8		16.28	16.58	21.01	18.29	16.49	
9		15.50	15.77	19.30	17.61	16.56	
10	Average	15.97	16.36	20.77	17.39	16.47	

Sugg-Letheby burner.
E. G. LOVE, Gas Examiner.

The Citizens' Gas-Light Company of St. Joseph, Mo, the stock of which is almost entirely owned in this city, has sold out to a new company. Contract price $78,000, out of which sum some $55,000 of bonded debt is to be paid. It can be productive of no public good to give a list of stockholders.—*Ann Arbor Argus.*

[From "Journal of Gas Lighting."]

British Association of Gas Managers.

READING OF PAPERS.

The reading of papers was then proceeded with. They are here enumerated in the order in which they were read, and we reserve their publication, and our report of the discussions thereon, as usual, for succeeding numbers.

The first paper, prepared by Mr. Richards, was read by Mr. F. W. Hartley, in the absence of the author. The subject was "Brick, Concrete, and Composite tanks."

Mr. A. PENNY, of London, read a paper on the "Transfer of Gas Works."

Mr. G. LIVESEY, of London, read a paper on "Capital and Revenue."

Mr. G. HUNT, of Birmingham, read a paper on "Preventable Waste."

Mr. J. METHVEN, of London, read a paper on "A New Standard for Determining the Illuminating Power of Gas."

In the evening a lecture was delivered before the members by Mr. Thomas Wills, F.C.S., on "The Products of Combustion."

WEDNESDAY, JUNE 19.

The PRESIDENT took the chair at ten o'clock, and the reading of papers was resumed.

Mr. T. TRAVERS, of Cork, read a paper on "Some of the Causes Tending to Retard the Application of Gas for Heating Purposes."

Mr. F. D. MARSHALL, of Brentford, read a paper on "The Purification of Gas by Liquids."

Mr. F. LIVESEY, of London, read a paper on "Some Experiments with Ammoniacal Liquor as a Purifying Agent."

Mr. G. E. DAVIS, of Manchester, read a paper on "The Correct Method of Analysis, and the Correct Valuation of Residual Products."

Mr. G. E. STEVENSON, of Peterborough, read a paper entitled "Some Notes on the Construction of Retort Settings."

Mr. S. LEONI, of London, read a paper on "Cooking by Gas."

Mr. W. T. CARPENTER, of Sheerness, read a paper on "Improvements in Carbonizing Apparatus."

ELECTION OF HONORARY MEMBERS.

The PRESIDENT then proposed that the Association should elect as Honorary Members the President and Past Presidents of the Société Technique de l'Industrie du Gaz en France. This, he said, would only be reciprocating a courtesy which their sister Society in France had already paid them, and the Committee, therefore, unanimously recommended that they should be elected.

This was unanimously agreed to.

The PRESIDENT said they were very glad to welcome amongst them at that meeting three members of the profession from the other side of the Atlantic. He understood, from gentlemen who had visited America, that they were received by their brethren there with the greatest kindness, and every effort to make their visit pleasant and profitable. He had, therefore, to propose, as an expression of the pleasure they felt in seeing these gentlemen amongst them, that they should elect Captain G. Warren Dresser, the Editor of the AMERICAN GAS-LIGHT JOURNAL, who had long occupied a prominent position amongst gas men in America, as an Honorary Member of the Association.

The resolution having been carried unanimously,

CAPTAIN DRESSER said this honor was entirely unexpected, and he could not take it as addressed to himself in the slightest degree. He understood that the spirit in which it was given was not in honor of him as an individual, but his countrymen. Some of them had come over to see if they could learn something in the mother country, and they would be extremely delighted to go back and tell their brethren with what kindness, honor, and distinction they had been received.

ELECTION OF COMMITTEE AND OFFICERS.

The SECRETARY read the report of the Scrutineers as to the result of their examination of the ballot papers, from which it appeared that the following gentlemen had been elected for the ensuing year:

President—Mr. W. J. Warner.

Vice-Presidents—Mr. J. Douglas, Mr. C. Hunt, and Mr. G. W. Stevenson.

Treasurer—Mr. H. Newall.

Secretary—Mr. W. H Bennett.

Committee (new members to replace those going off by rotation)—Mr. J. Braddock, Mr. W. Carr, and Mr. R. H. Jones.

Finance Committee—Mr. G. Livesey, Mr. J. Eldridge, Mr. G. W. Stevenson.

Auditors—Mr. A. Hersee and Mr. A. Lass.

REPORT OF COMMITTEE.

The SECRETARY read the following report:

"Obedient to the instruction of the last general meeting, your Committee have considered the proposition made by Mr. Travers—that the bounds of the Association should be enlarged so as to admit of Water Engineers to membership.

"Your Committee fully recognize the fact that to a certain number of the members, to associate the duties of gas and water managers, there would be an advantage in the change proposed, and that to such, papers and discussions on water-works topics would be interesting and profitable. They feel, however, on the other hand, that the change proposed would be a radical alteration in the character of the Association, which circumstances do not call for, and which, in its effect, is more likely to produce embarrassment than advantage. Desirable as it may be to add to the number of our members, it is of still more consequence that the proceedings of the meeting should interest and help those who attend them. Your Committee are of opinion that the consideration of gas matters would not prove attractive to gentlemen whose business was confined to water works, and *vice versa*. A consequence would probably be that members would, to a greater extent than at present, absent themselves during a portion of the proceedings. Your Committee are, therefore, of opinion that it would not be beneficial to the Association to make the alteration proposed.

"Your Committee desire to call the attention of members to two other matters—

"*The Financial Position of our Association.*"

"On this point they cannot do better than adopt, as their own, the following passage from a report to them of the Finance Committee, dated March 28, 1878, which is as follows: 'Your Committee have given their attention to the financial state of the Association, and they find that the recommendation contained in their report of last year, that the members should be informed that a slight increase in the subscriptions was necessary, in order to make the income superior to the expenditure, has met their expectations, and that there is a balance of about £15, on the year 1877, in favor of the Association. Although your Committee do not consider it desirable that there should be any considerable annual increase in the balance carried forward, they are of opinion that provision should be made to prevent occasional deficits in future. Your Committee recommend that, in future, arrears of subscriptions should appear in the accounts of the year as an asset, and that subscriptions remaining unpaid at the end of the second year should be written off. In order to reduce the arrears as much as possible, your Committee recommend that the Secretary be instructed not to forward the copy of the transactions to any member until his subscription for the current year has been paid. The accounts will then be so clear and simple that it will be impossible to deduce erroneous conclusions from them.'

"Your committee, not prepared to advise the abolition of premiums, have decided to add to these recommendations of the finance committee this further one—that the subscription of all members elected in

future be fixed at a guinea, and not left optional, as at present.

"The second matter which has engaged the Committee's attention, and on which they now report, is

"*The Nomination of Members of the Committee.*

"This was the subject of some discussion at the Bristol Meeting, ending in a resolution confirming the present rule. Your committee felt, however, that although it was very undesirable to make alterations in the rules at a general meeting without notice, and where it was impossible to spare sufficient time for the proper consideration of the proposal made, yet it was their duty to give attention to any suggestion made at the meeting.

"The committee have had the advantage of suggestions from several members since the discussion took place, and they now submit the following plan for consideration, which has been designed to meet the views of those members who think the committee are not sufficiently representative of the whole body:

"It shall be open to any member to propose another as a member of committee. If the proposal is duly made, and supported by the names of two other members, and sent to the Secretary on or before the 31st of March preceding the annual meeting, the committe shall accept the nomination, and include the name of the gentleman so proposed in the voting list. No member shall propose or support the nomination of more than one member of committee in the same year.

"Further, the number of names to be nominated by the committee shall be reduced from twelve, as at present, to six; but in the event of their not being six names nominated by other members, the committee shall fill up the number to twelve, as required by the rule. The committee recommend that Rule 30 be altered in accordance with this suggestion.

The PRESIDENT moved that the report be received, which having been carried, he invited discussion upon it. He said if there were no remarks to be made upon it, he would ask some member of the committee to move its adoption. He might say, however, that the committee had looked very carefully into the matter, and they felt that the suggestions made at the last meeting had considerable force in them, that the election of members of the committ- should be made as fully representative as possible, and that therefore it was advisable the constituency proposing them in this way. Now that the rule was proposed to be altered, he could only express his hope that members would avail themselves of it, and that it would not be left to the committee to nominate the whole number, though he should not be much surprised if such proved to be the case.

Mr. WEST (Maidstone) moved the adoption of the report.

Mr. HEPWORTH (Carlisle) seconded it.

Mr. CARR (Halifax) said there was a remark in the report to which he objected—namely, where it stated it was hoped it would meet the views of gentlemen who did not think the committee were sufficiently representative. He, himself, did not know who were the people who held that opinion; and he was present during the whole of the discussion twelve months ago, and took part in it, and he did not remember any one making the charge that the committee were not sufficiently representative. The only objection taken to the rule was that the nomination placed the committee in rather an unfortunate position, and it was with a view to remove the possibility of any member saying they were not represented by the committee that this was proposed. He was much pleased that the committee had taken the matter in hand and dealt with it in the way they had. He believed they had given the matter their best consideration; and the plan they proposed, was, no doubt, the best, under the circumstances. They had shown, not only their representative character, but their desire to push the best interests of the Association, and he believed now it would be utterly impossible for any section of the Association to say they were unfairly represented. They must always go by the majority of members, and they would have the opportunity of trying their strength at any time they felt disposed.

Mr. STONE (Weymouth) said one part of the report seemed rather hard—namely, that which would compel new members to subscribe one guinea. He feared this would deter many managers of small gasworks from joining, because it would be a great burden to many men in such a position, who were really those most requiring the privileges of the Association. They were a great many members of the Association at present who would not feel it a hardship to subscribe one guinea, if necessary; but many did not think it necessary to do so at all. The expenditure of the Association had for several years been increased to what some thought an alarming extent. Many years ago the funds of the Association improved until they got to something like £400 in hand, but for two or three years past they had been gradually diminishing. Thus it happened, unfortunately, that the richer they got the poorer they were. The question was whether they should meet that position by increasing the subscriptions or diminishing the expenditure, and he should rather advocate the latter.

The PRESIDENT said, as the remarks of the last speaker seemed to be received with favor by the meeting, he should be glad if those who were of the same opinion would express it.

Mr. JONES (Chesterfield) said he took part in this discussion somewhat reluctantly. He thought that the change shadowed forth in the report now presented was of such serious importance that they ought to have more time for its consideration. With reference to the introduction of managers of water-works, he regretted that the committee could not see their way to advise the Association to try the experiment. Representing as he did a water and gas company with a capital of £300,000, he did not think his position as a gas manager was at all disparaged by being associated with the Water Department. He should like to see their brethren in the water line associated with themselves, as there were many points in common which might be dealt with by the Association to the advantage of both water and gas engineers. The point, however, to which he wished more particularly to allude was the rate of subscription, and he agreed with his friend, Mr. Stone, that it was highly desirable for that portion of the report to be re-considered. In times like the present, they could not expect men who were managing small gas-works to be throwing away a guinea for one meeting a year, and there were many things in which the expenses might be curtailed. For instance, he found the secretarial expenses of the North of England Institution of Mining and Mechanical Engineers averaged 22¼ per cent. of the incoma, and they had five meetings a year. The Chesterfield and Derbyshire Institute of Engineers, of which he had the henor to be a Councillor, averaged a smaller percentage for secretarial expenses, and they had five meeting a year, and their transactions were most elaborately got up. The Secretary of the Association, however, received more than 36 per cent. of the income, for one meeting a year. He was quite satisfied that the finance committe could see their way, if they would, to diminish their expenditure, instead of raising the subscription. They were paying the Secretary excessively, and most excessively for office rent. The office rent was £40 a year. The Secretary £140, and there was a further charge of £9 8s. 9d. for traveling expenses of the committee. Time was when the gentlemen who served on the committee were content to sacrifice their time.

The PRESIDENT, interposing, remarked that, while he hoped all members who wished would express their opinion on this point, he must ask them to bear in mind the lateness of the hour, and the short time in which they had to get through the business.

Mr. JONES said he regretted exceedingly, as he was in order in discussing the financial position of the Association, that he was not allowed to proceed.

The PRESIDENT said he had not the least desire to ask Mr. Jones to conclude his remarks at once; he only wished to point out to him that he had already occupied a conside.able time.

Mr. THORNELOE suggested that it would be as well for the Secretary to retire while this discussion took place.

[The Secretary expressed his perfect willingness to do so. The members generally, however, seemed to express dissent.]

Mr. JONES said he did not wish to take up time unnecessarily, and he would, therefore, simply move that the report, as presented, be ordered to lie on the table, so that members might have time to consider it.

Mr. MEAD (Sutton) was anxious the members of the Association should always continue to act as harmoniously together as they had in times past. It might be in the recollection of Mr. Jones and others, that the Secretary's salary had been increased by themselves without any application from him; and, under those circumstances, it would be ungracious now to find fault with the amount he received. That they had an excellent Secretary, no one could doubt, and that they would have great difficulty in finding another who could do the same work so well as he had done it. He (Mr. Mead) trusted, therefore, that, whatever their opinion might be, they would not think of withdrawing any part of the salary they themselves had voted. As to the question of subscription, he could not conceive that any gas manager could consider that 21s. a year was too much to pay for the privilege of attending these meetings. He had had a great many years experience of gas matters, but he had never attended a meeting without going away the better for it.

Mr. BARRETT (Grantham) said he knew there was a wide dissatisfaction on the part of many members as to the financial position of the Association, and the manner in which the business had been conducted. He, therefore, had great pleasure in seconding Mr. Jone's amendment, in order that the question might be properly ventilated. He was not satisfied with their financial position, and thought that the expenditure was considerably more than it ought to be. It would be a serious infliction on many good men who wished to join the Association if the subscription were raised as proposed. There were no men better able to judge what a man was worth than gas engineers; for it was part of their constant duty to calculate minutely the expenditure in every department, and if there were any excess anywhere, to put their finger upon it and have it altered. He hoped, therefore, the subject would be discussed calmly and dispassionately; but he could not help saying that he was not satisfied with the manner in which the secretarial duties were performed.

Mr. GEORGE LIVESEY thought the discussion was taking a course which would be anything but beneficial to tha Association, as it seemed becoming a personal question He would also point out that there were many other matters in the report besides the one to which attention was now drawn, and which it was important should be settled, and settled at once. Then he would also ask, in reference to the Secretary, whether the members, any of them, were in a position to know what the duties performed by that office were. One only knew what a man was worth when one knew what he did. Having himself been connected with the Association officially for something like ten years, and having, perhaps, seen as much of the work done by the Secretary as any one, he considered the salary received was anything but too large. They had in Mr. Bennett a man who devoted himself heartily to the interests of the Association, who was always thinking how he could best promote those interests, and to bring up this question in the way it had been done, after Mr. Bennett had served the Association well all these years, was anything but praisworthy on the part of any members. Nor was there any necessity for it. The whole question had arisen upon the subject of raising the subscription from a half to one guinea. As a member of the finance committee, he fully accepted the responsibility

of that recommendation, but he did not insist that it was essential to the prosperity of the Association. He had gone into the accounts carefully, and he found that, with the exception of one single year, the expenditure had always been less than the income. The accounts had certainly been published in a form which did not clearly express the exact position of the Association; and the finance committee, in order to avoid arrears in the future, made the recommendation in the report. Last year the income was about £30 above the expenditure. It was not necessary, therefore, to increase the subscription, though he thought it was advisable. He thought 10s. 6d. was too low; and, besides, he thought the subscription ought to be paid by the companies or corporations, and that, if the matter were properly brought before them, they would do so. The point before the meeting was, therefore, whether they should have an increased subscription for future members. The existing members would go on paying the same, if they choose, and there would be no pressure put upon them to pay more. He thought this matter might be put to the vote, and then the other points in the report could be taken on their merits. As to roducing the Secretary's salary, he was quite certain the members generally would not listen to it for a moment.

The PRESIDENT asked if Mr. Jones would be willing to withdraw his amendment in order to put the question suggested by Mr. Livesey.

Mr. JONES had no objection personally to the course suggested, but he should like to take the opinion of his brethren before consenting.

The PRESIDENT said he could not allow another speech.

Mr. JONES said in that case he must decline to withdraw his amendment.

Mr. SMITH (Darlington) thought that, according to Mr. Livesey's own view, there was no necessity for raising the subscription, for it appeared that in every year but one their assets had been in excess of the liabilities, If, as Mr. Livesey suggested, gas companies or corporations paid the subscriptions for their managers, it would be then time enough to increase the subscription; but until such was the case he thought the committee had scarcely any ground for making such a recommendation.

The PRESIDENT said he should have preferred to put the report paragraph by paragraph, but as Mr. Jones' amendment was not withdrawn he was obliged to put it.

Mr. IRONS (Gosport) suggested that the mover of the original resolution should consent to its being altered so far as regarded the paragraph referring to the subscription. They ought to consider the persons who formed the Association, and who fixed the rate of subscription at 10s. 6d. In early times they were much indebted to two eminent men, the late Mr. Barlow and Mr. Hawksley. He remembered Mr. Hawksley being in the chair as President when a similar question was brought forward, and he strongly advised that while the subscription might be increased to one guinea for those who were willing to pay it, it ought not to be increased compulsorily. The objection that many felt to the paragraph in the report was that it would make an increase compulsory for future members, and as there was no real necessity, he asked the committee to withdraw that part, so that the meeting might adopt the rest, which was very serviceable.

The PRESIDENT entirely agreed with Mr. Iron's remarks, but he had no option but to put the amendment.

The amendment was then put, and lost by a large majority.

Mr. GEORGE LIVESEY proposed another amendmont, to the effect that the paragraph relating to the increase of subscriptions be expunged.

Mr. CARR seconded this amendment, which, on being put to the meeting, was carried almost unanimously.

The PRESIDENT, in putting the original motion, with the paragraph relating to increased rate of subscription expunged, said it would be hardly necessary to discuss it further, after what had taken place; but he would remind the members that it was the outcome largely of the discussion which took place at the Bristol meeting, where it was argued that it was impossible to discuss the proposal then made, and it was therefore negatived. The committee, however, felt it their duty carefully to consider whether the meeting had been acting rightfully in negativing the proposal, and in the interval they had most carefully considered the suggestions made. The members need not be under any apprehension, therefore, that, in adopting the report, they were doing things hastily or inconsiderately.

The motion was put, and carried *nem. con.*

MEMBERS IN ARREARS.

The SECRETARY then read the list of those whose subscription having been in arrear for two years, had *ipso facto* ceased to be members.

TIME AND PLACE OF NEXT MEETING.

The PRESIDENT said the next business was to choose a place of meeting for next year.

Glasgow, Newcastle-on-Tyne, Portsmouth and Sheffield were all proposed by various gentlemen, but Portsmouth was afterwards withdrawn. During the conversation which took place,

Mr. HUNTER (Salford) suggested that in future it would be well if some formal invitation was sent up from Provincial towns, because it was very easy for gentlemen to get up and propose a certain place of meeting, without having taken any means to ascertain whether a visit would be locally acceptable.

Mr. HEPWORTH (Carlisle) said the North of England Association had considered this matter, and, though they had not sent a formal application, they were unanimously of opinion that it would be the greatest pleasure the Association could confer upon them if they would meet next year in Newcastle-on-Tyne.

On a vote being taken, the meeting decided by a very large majority in favor of Newcastle.

VOTES OF THANKS.

The PRESIDENT then moved a cordial vote of thanks to the gentlemen who had contributed papers. He said he was hardly in a position to express a fair opinion as to the character of this meeting, as compared with others; but, personally, he thought it had been very successful, for he felt sure that a better set of papers they had never had. The attention with which they had been listened to, and the large attendance while they were being read, had been the best testimony as to their character. He would, of course, include in the vote those gentlemen who had prepared papers which, for want of time, had not been read.

The resolution was put, and carried unanimously.

Mr. WARNER said he felt very deeply the high honor conferred upon him in electing him as President for the coming year, and he was quite sure that the people in Newcastle-on-Tyne would equally feel it their duty, as he felt it his, to advance the interests of the Association, and to maintain its high honor.

Mr. OHREN moved a vote of thanks to the committee for the manner in which they had carried on their duties during the past year, and for the report which had been adopted.

The motion was carried unanimously.

Mr. HENRY WOODALL moved a vote of thanks to the Treasurer, Mr. Newall, whose operations, he said, reminded him of the laws of nature; they were always constant, though never seen.

The resolution having been carried unanimously,

Mr. STORER moved a vote of thanks to the Scrutineers, Mr. Hartley and Mr. Darwin.

This resolution was also carried unanimously.

Mr. HEPWORTH moved a vote of thanks to the Society of Arts, whose hospitality they had always experienced when coming to London, and to Mr. Le Neve Foster, the Secretary. He never came to that room without thinking also of the indirect aid which the Society of Arts had given to their Association, by the publication of some very valuable lectures on subjects connected with their operations.

The resolution was carried unanimously.

Mr. GEORGE LIVESEY said he was called upon to perform an act of justice, which the Society had for some time neglected. In former years the Association were accustomed to pess a vote of thanks to the late Mr. Barlow for taking notes of the meeting, and furnishing them to the Society, thus contributing very largely to their income, and diminishing their expenses. That kindness had been continued by his successor, Mr. King; and he hoped Mr. King would not feel it had been a slight on the part of the Association that they had never acknowledged his kindness. It had been generally understood by the members that Mr. King had done this voluntarily and generously, though, somehow or other, they had omitted to pay a formal acknowledgment of the services thus rendered. It was their bounden duty to express their hearty thanks to Mr. King for his great generosity, without which the Association would have found before this that the half-guinea subscription was insufficient to meet their expenses.

The PRESIDENT, in putting the motion, said as there had been an omission before, he hoped the members would, if possible, throw the fervor of half a dozen years into the vote of one. They all felt such personal regard and friendship for Mr, King, and such an interest in the work he was doing, that it was always very pleasant to them to see him among them.

The resolution having been carried unanimously,

Mr. King acknowledged the vote, and thanked the meeting for the very cordial manner in which it had been adopted. His predecessor in the conduct of the *Journal*, the late Mr. Barlow, had always manifested great interest in the prosperity of the Association, and he had himself been influenced by the same spirit. It had been his happiness to attend every meeting of the Association since the first gathering in Manchester, in 1863; and he had personally reported the proceeding each year until now that the state of his health prevented him from undertaking the labor. He was glad, however, to be present on this occasion, and, with the aid of his friend at his side, to continue his work. Any assistance he had rendered to the Association had been rendered with much satisfaction to himself.

Mr. MORTON proposed a vote of thanks to the President. He wished some one better fitted to speak of him had been chosen, although no one knew better than he the high qualities of Mr. Corbet Woodall. He had been intimately associated with him throughout his professional career, and had seen with much pleasure the progress he had made therein. He therefore proposed a cordial vote of thanks to Mr. Woodall for his conduct in the chair, for the onerous work he had done for the Association during the year, and especially during the past month, and for the admirable address with which he opened the meeting.

The resolution having been carried by acclamation,

The PRESIDENT thanked the meeting for the kindness with which they had received Mr. Morton's remarks. He could only say there were few things more satisfactory than to hear, as he had heard, for the first time, that Mr. Morton's acquaintance with him for a term of years had not diminished the regard with which it commenced. He could only say, with reference to the proceedings of the last two days, that they had been to him a source of continued satisfaction and pleasure He commenced his duties with considerable misgivings, but his apprehensions vanished almost from the first moment of taking the chair, and the confidence he experienced in the cordial support he should receive from the members had been more than fully realized. Before sitting down, he wished to propose a vote of thanks to the Secretary. He was particularly glad of the opportunity of being able to say a word or two with reference to that gentleman. He had no idea, until the commencement of his year of office, what the amount of attention and labor was that developed on the Secretary of the Association. He could assure the meeting

most emphatically, that if those duties were rendered in return for the emolument received, he should regard the remunera ion given as utterly inadequate to the services performed. Furthermore, he did not believe that those services were rendered for the sake of the emolument, but they were done by Mr. Bennett with a hearty and loving service, which was of great value to the Association.

The resolution having been carried unanimously,

The SECRETARY briefly and appropriately thanked the members for their kindness.

This being the whole of the general business, the meeting was brought to a close.

THURSDAY, JUNE 20.

At eleven o'clock this morning the members assembled at the Phœnix Gas Company's gasholder-station in Kennington Lane, to witness the progress made in the construction of the largest gasholder at present in existence. Here they were met by Mr. Shand, the Deputy-Chairman of the Company, from whom they received a very hearty welcome, which was cordially acknowledged on their behalf by Mr. Warner, the President of the Association for the coming year. Mr. Woodall, the engineer of the company and present President, furnished the visitors with every desired information respecting his large and important work, to which, however, it is here unnecessary to refer, as the drawings and details are in course of publication in the *Journal*. After spending two hours at the works, partly in doing justice to a choice refection provided for them by the Phœnix Gas Company, the members proceeded to the Vauxhall station of the South-Western Railway, whence they were conveyed to Hampton by train. Here an inspection of the works of the Grand Junction and Southwark and Vauxhall Water Companies reservoirs, engines, &c., took place, and an adjournment to Bushey Park followed, where, after partaking of an elegantly appointed luncheon, the remainder of the day was spent in viewing the great hall, picture gallaries, and grounds of Hampton Court Palace, the company returning to London about eight o'clock in the evening.

On Friday, June 21, those of the members who intended to visit the Paris Exhibition started from the Victoria Railway Station at 7·40 A.M. for Dover, whence they proceeded, *via* Calais, for the French capital.

We have been favored by correspondents with narratives of the engagements of the following days.

On Saturday morning, at ten o'clock, the members visited the Exhibition, where they were met by MM. Arson, Servier, Ellissen, and several other gentlemen, in the Pavillon de la Compagnie Parisienne du Gaz, who explained to them the interesting exhibits of that company, including elaborate medels and drawings of their apparatus, drawings of the brick-works and tar and ammonia plant, samples of products, stoves for cooking and heating by gas and coke, gas-engines, main pipes, and the method of attaching services, &c. This visit was altogether of great interest, and the members were much impressed by the thoroughness with which the Paris Gas Company had carried out their exhibition.

In the evening, by the invitation of M. Denayrouze, through Mr. Woodall, about 100 of the party assembled at the works of the Electric Light Company, in the Avenue de Villars, and received from M. Jablochkoff and his assistants a very interesting explanation of the apparatus employed in electric lighting as now used in Paris. Afterwards, by the courtesy of the Electric Light Company, the whole party was invited to the concert in the Orangery of the Tuileries Gardens, where they saw the orchestra and grounds illuminated by 48 electric lamps.

On Monday the Paris Gas Company received the members of the British Association at their works at La Villette. Every care was taken by the officers of the company to explain what was new or strange to the visitors, and the latter expressed very generally admiration of the care taken by the company to utilize every source of profit open to them. The tar, ammonia, brick retort, and patent fuel works were all in turn examined, and note books were in constant requisition. After this inspection the members of the British Association drove to the gas works at Ivry, where they were met by the members of the Société Technique de l'Industrie du Gaz en France. A beautiful luncheon had been prepared by the Paris Gas Company for the whole party, numbering about 250, in one of the retort-houses, which had been very prettily decorated for the purpose. After the luncheon, and a hearty acknowledgement of the company's kindness, an inspection of the Siemens furnaces in use for heating the retorts concluded the visit. In the evening a banquet was held by the Société Technique, on the island of the Great Lake in the Bois de Boulogne, to which the President and committee of the Association were invited. About 60 ordinary members also joined the party. The proceedings of this evening will long remain in the recollection of those who took part in them. The lovely scenery, charming music, and hearty welcome were alike fully appreciated. The health of the British people, and especially the Association of Gas Managers, was cordially drunk, and the reply of the President (Mr. Woodall) was received with hearty applause. The toast of the Société Technique and the French people was proposed by Mr. Woodall in terms which secured enthusiastic concurrence, and the most delightful concord prevailed throughout.

The proceedings of the Société Technique on Monday were attended by a large number of the English visitors, who took some part in the discussion carried on.

On Thursday morning a large proportion of the party returned to London, but many remained to see the National Fête on Sunday last. All alike have heartily expressed their satisfaction with the visit, and the arrangements made for their reception and entertainment.

TUESDAY, JUNE 18.

The first paper was by Mr. W. Richards, and was read by Mr. F. W. Hartley, in the absence of the writer. The subject was—

BRICK, CONCRETE AND COMPOSITE TANKS.

In the construction of gas holder tanks, the first consideration is, of course, the stability of the ground, that the foundation shall be sufficiently solid, in order to sustain the weight of the tank, water and holder, without settlement; but, as this is essential in every class of structure, further reference to it will not be made.

The other important points connected with my subject are—the nature of the building materials employed in the bulk of the work, whether these be brick, stone, shingle, gravel, or other similar substances. Also the means of uniting or cementing those materials together, either with hydraulic lime mortar, which possesses its hydraulic property in consequence of the lime containing a quantity of argil; or whether a purer lime be employed, and rendered hydraulic by an admixture of a substance such as Puzzolana: or by the employement of Portland or other cements. Lastly, we have too consider the proper means of employing these materials, which, as will be shown hereafter, constitute the most important of the operations in the construction of tanks.

It may be briefly stated that bricks, brick ballast, as well as some kinds of stone, are more or less porous; but how far this influences the proper construction of a tank I will have occasion to demonstrate. On the other hand, many kinds of stone, as well as shingle, the pebbles entering into the formation of gravel, and the grains of sand, so far as regards their impermeability, leave nothing to be desired. With these, therefore, the means of uniting them together with hydraulic mortar or cement is all that is requisite in order to form a tank, at least so far as regards the materials employed.

Respecting the mortars and cements, it may be observed that hydraulic limes can only be obtained in certain localities; and, as they are not sufficiently valuable to bear heavy expenses in carriage, for these reasons their use is limited. Puzzolana is comparatively little known to England, which is to be regretted, on account of its great value; indeed, such is this value, that when a small portion of Puzzolana is intermixed with good lime mortar, whether for concrete or other uses, the compound possesses nearly all the properties of Portland cement, except that it requires a longer time to set and harden. Moreover, as Puzzolana exists in the neighborhood of Edinburgh, opportunities are afforded for its more general employment in the United Kingdom, which is further encouraged by its low price, and the small quantity required to be intermixed with the mortar in order to render it hydraulic.

There are various kinds of hydraulic cements, but that which experience has proved to be the best for our purpose is the Portland, and to which my observations will be principally confined.

Among the advantages this possesses are—its moderate price, that it can be mixed with two and even three times its volume of clean sand and still retain an extraordinary degree of tensile strength or cohesion, that in setting it neither contracts nor expands, and that it may be stored in barrels in a dry situation for many months without suffering any deterioration beyond the simple circumstance that it requires a somewhat longer period to set than if freshly made. But, whether recently manufactured or otherwise, or employed pure or intermixed with proper proportions of sand, this cement has the property of hardening, in the course of time, in a wonderful manner. In confirmation of this statement, I have only to refer to the pavement in some places in London, set therein, in which the cement projects in polished ridges, while the stone adjoining is worn into deep recesses. But a still more striking fact is that paving stone is replaced with advantage by slabs formed of the cement in question, intermixed with sand; and such is the resemblance between the artificial and natural stone that to the unitiated it is a matter of difficulty to distinguish between them. A few years ago, in a highly interesting paper, read before this Association by Mr. Douglas, that gentleman mentioned some of the advantages of Portland cement. Among those, he observed that a beam composed of it, of four inches square, and 14 inches long, on being fixed at one end, bore a weight of 1580 lbs. placed at the other end, thus possessing, as he observed, half the strength of Riga fir timber.

We find in some reference books that a definite degree of cohesion is stated to exist, in ordinary work, between the bricks and mortar, which is usually estimated at about 60 lbs. per square foot; but, to show the error of this, we find in observing houses in a state of demolition, in almost all cases the mortar is actually crumbling to dust, thus clearly proving that no material cohesion exists; and instead of the mortar hardening with time, as it certainly should, if properly prepared, the opposite is the fact, which arises from the indifferent kind of materials used in the first instance; but, as I shall have occasion to show, in order to produce sound work, as much depends on the manipulation as on the materials employed.

The accepted theory of the action of mortar is, that the hydrate of lime possesses a greater affinity for the silica composing the sand intermixed therewith, and that in the course of time, by the lime absorbing the carbon from the carbonic acid existing in the atmosphere, it is again converted into the carbonate of lime, similar in nature to that it possessed prior to calcination, which is further assisted in acquiring the desired degree of hardness by the particles of silica in combination therewith. And undoubtedly, when due care is observed in the selection of the materials, particularly when the sand is granulated and clean, with good lime, in the course of time the mortar made with these acquires a stone like hardness; but when mortar is prepared with loamy sand, or with certain earthy substances, it can neither possess any proper degree of cohesion, nor become hard, simply because

the action of the lime is counteracted by the presence of the foreign pernicious substances.

As ocular demonstration is always more forcible than any verbal description, I have prepared a few specimens of Portland cement, in order to illustrate my arguments, which specimens were all made with the same description of cement, but under different circumstances. Thus No. 1 consists of six flat tiles, cemented together *when in a dry state*, which, after being allowed a considerable time to set, on the cement becoming hard, with a slight blow the tiles were easily detached; from which we learn that a very limited degree of cohesion exists between cement or mortar and bricks stone, or other materials, when the latter are in a dry state.

Now, if the same description of tiles be thoroughly saturated with water at the instant of cementing, a very different result is obtained, as may be observed in specimen No. 2, in which the cement is so intimately incorporated with the other that the tiles actually break before becoming detached. Hence we find that, to obtain perfect cohesion, it is absolutely necessary that the bricks or other material shall be thoroughly saturated at the time of operating.

As a further trial of the adhesion of Portland cement, the specimen No. 3 was prepared. This is simply a cylinder of that material, of about six inches long and one square inch in sectional area, and at each end is placed a wire in the form of a hook or eye, which wire is enclosed for a short distance in the cement, and intended for the purpose of testing its cohesive strength. To this was suspended a weight of 112 lbs., without the cement breaking, and how much more it would bear I am unable to say, as I did not possess the facility of testing it; but, confining myself to this limit, and taking this specimen as a basis, we find that Portland cement has a cohesive force or tensile strength of 112 lbs. per square inch, or no less than upwards of seven tons on the square foot, which agrees approximately with the statement of Mr. Douglas already referred to. But according to another statement by that gentlemen in the communication mentioned, at the end of 30 days Portland cement possesses the extraordinary tensile strength of 417 lbs., and at the end of two years, 675 lbs. per square inch, or nearly 40 tons per square foot of surface. With this remarkable material at our command, it seems astonishing that the same thickness of walls of houses and tanks adopted many years ago should be still retained, and that engineers do not avail themselves of the remarkable cohesive strength of Portland cement and other similar materials.

Now, speaking theoretically, and taking the strength of the specimen as a basis, the small tank No. 6, of a thickness of one inch, if made of pure cement, should bear the pressure of a column of water 200 feet high, and this without hooping, or any other external support, and a brick tank of one foot thick, supposing every care to be observed in its structure, would be more reliable than any cast-iron tank, with its bolts, nuts, flanges, and hoops. Briefly, in ordinary constructions, instead of proper importance being attached to the cohesive force of the mortar or cement, a thickness of wall or weight of material is brought to bear against the pressure of the water, which is further aided by the pressure of the ground on the exterior of the tank; but I venture to say that, if proper consideration is given to the cohesion of the cement or mortar, and ordinary care taken to ensure this, then the walls of tanks may be reduced to a considerable degree with a corresponding economy.

I now request your attention to composite tanks, which I believe were first constructed by Mr. V. Wyatt, and from which I will pass to those of concrete.

Originally the sides of composite tanks were formed by an inner and outer wall of brickwork of limited thickness, leaving an intervening annular space, which was gradually filled with concrete as the wall were carried up. Subsequently, improvements were introduced by dispensing with the outer wall, in its place a moveable frame was adopted to retain the concrete until it became set.

But in neither of these constructions was the concrete intended to retain the water, but simply to give strength to the structure, and, as Mr. Wyatt observed on one occasion, he did not believe for one moment that concrete could be made water-tight, that he had built walls ten feet thick, and yet the water came through like a sieve.

I may here observe that a system similar to the first mentioned is adopted in some parts of the Continent, for the formation of water and wine tanks—that is, by having an inner and outer wall of stone, with the intervening space filled with hydraulic concrete. When constructing these, in a wall two feet thick, with a space for the concrete of about 15 inches wide, the concrete is composed of stones, varying in size from a hen's egg to gravel, with an abundance of hydraulic mortar or cement in a liquid state; and, whenever a quantity of concrete is placed, a man is employed to probe it continually at the sides in order to eject the air, which would otherwise be formed in "pockets," as seen in specimen No. 5. The tanks made as described are often employed to contain wine, and in every respect are successful, and their impermeability is due entirely to the concrete; therefore, I ask, why cannot the same degree of excellence be attained with gasholder-tanks?

To resume my notice, a further progressive step made by Mr. Douglas, by building a tank entirely of concrete, which he afterwards lined with brickwork, as he observed, "to gratify the eye." In the formation of this tank, the cement was not intended to hold the water, for, as Mr. Douglas said "it would leak like a colander," and so it undoubedly would if not properly prepared.

The next important achievement to be noticed in the class of tanks under consideration was that erected at the South Metropolitan Gas Works, in which not a single foot of stone—in the ordinary acceptation of the term—or a single brick, entered into its formation, the whole being constructed entirely of concrete, afterwards rendered on the interior with pure Portland cement; moreover, in the construction of this vessel, puddle was entirely dispensed with. The experiment was one of remarkable boldness on the part of Mr. Livesey, and, on the whole, was successful, and that gentleman has done good service by showing the inutility of puddle, which at one time was considered indispensable, whatever it might cost. In this tank also the concrete was not relied on to retain water.

We now come to the consideration of the construction of tanks, and particularly in the formation of concrete, in which, as I will show, the cement unites the masses of shingle, or ballast, with a degree of success, both as regards cohesion and impermeability, depending entirely on the manner the operations are conducted. I must, however, express my diffidence in venturing assertions in opposition to universal practice, but as our desire is to acquire knowledge, and disseminate it, I am sure that if my remarks are soundly based on facts, the gentleman mentioned will be the first to recognize them at their proper value.

We see every day, in the formation of the foundation of roadways, and other work, the concrete is often prepared in the most careless manner, in which a portion of cement is thrown on the ballast, and on this being wetted, the mass is turned over two or three times, and is then placed in its position; but by these means at least one-half of the ballast never comes in contact with the cement, and it follows that, as *concrete*, that portion is useless, and, of course, prepared in that manner, it must be porous.

But, on the other hand, if the ballast be clean and well wetted, and a sufficiency of cement or mortar gauged or mixed with its proper quantity of water, then, on combining the ballast and cement, and turning them over several times, the cement will percolate throughout the mass, so that no interstices exist; consequently, on setting, the concrete becomes impermeable, and in three or four weeks attains that degree of hardness, that on applying a hammer and chisel the stones frequentiy split before becoming detached.

A popular error is the opinion that Portland cement, like some others, is injured by the slightest excess of water. This, however, is not correct, as concrete formed with it can be thrown into shallow water, without any material deterioration beyond the small quantity of cement which may be washed out in the operation.

To illustrate the important methods of making concrete, Specimen No. 4 was prepared with loamy gravel in a dry condition, intermixed with one-third its volume of cement. This breaks with facility, clearly showing that the strength of concrete is impaired by employing dirty concrete, and any carelessness in its preparation. With the same kind of material, and under conditions similar to those observed in making the last specimen, the tank No. 5 was made, and, as you may satisfy yourself, this system of construction, in the double sense of the term, "will not hold water."

For the purpose of illustrating the means of constructing concrete tanks in a superior manner and impermeable, the specimen No. 6 was made with all ordinary care with clean granulated sand, well wetted, and intermixed with the gauged cement, as already indicated, the materials being in the same proportions as No. 5. This is filled with water, and, as may be observed, it is completely water-tight without the aid of rendering, or any other means, beyond placing the material in a mould. In the absence of the proper appliances, the specimens are very rudely made, the principal object being to present to your notice the effects of different manipulations, and, above all, to prove that concrete can be prepared in such a manner as to be impermeable.

Blocks 7 and 8 were also made in a similar manner as the tank No. 6, the strength and impermeability of which are evident.

Therefore we find that the nature of concrete, both as regards strength and impermeability, depends on the manner it is prepared; and, by the proper admixture of the cement with the ballast, each stone or pebble or piece of brick, is surrounded with the cement, which adheres with the tenacity already stated. But, in the event of an insufficiency of cement, or the presence of dirt, in the first instance, a number of cells are left, through which the water percolates, and, in the latter case, the dirt impairs the action of the cement; and, in the course of time, the former is washed out, leaving a passage for the water. Lastly, as shown, when the brick or stone is not well wetted at the time of working, but little cohesion exists. As already stated, Portland cement hardens with time, and thus a proprly constructed tank would, in the course of one or two years, attain the hardness of hard stone; whereas, with indifferent materials, instead of hardening, the reverse is the case, when both strength and impermeability are sacrificed.

And here I may observe, that it may be objected that, in consequence of the limited dimensions of the model (if it may be so termed), it is not exposed to the same pressure as an ordinary tank; but, on the other, hand, it should be remembered that it is only one inch thick, and, if a comparison be made with large tanks of 40 or 50 feet deep, having their walls 4 or 5 feet thick, if this be duly calculated, it will be found, at least so far as regards their respective dimensions, that the smaller vessel is the more difficult to render impermeable,

With regard to the large proportion of cement employed, this, of course, is necessitated by the smallness of the pebbles and sand; but when ballast is employed varying in size from a hen's egg (or in extensive work still larger stones can be employed) to ordinary gravel, then the quantity of cement will be sufficient—that is, one yard of cement will be sufficient for twenty yards of concrete.

From the preceding statements, and the specimens before you, we learn that where bricks are laid in a dry state, that, notwithstanding the cement may be of the best, no material cohesion exists between them.

But when the bricks are thoroughly saturated with water at the instant of laying them, an incredible degree of cohesion is obtained, and it is to be regretted that advantage is not more generally taken of this property.

We also learn that the strength and impermeability of concrete tanks is mainly dependent on the manipulation, and that if any loom or dirt exists with the sand, or if the ballast be not thoroughly combined with an abundance of cement to fill all the interstices, that a structure of this kind cannot be relied on. But if only ordinary care be observed. concrete can be rendered impermeable for the construction of tanks, and it follows that whenever ballast is available at a cheap rate, concrete tanks may be made with a considerable degree of economy of course, dependent on the relative prices of ballast and bricks.

Hence, as ballast can be incorporated with cement to form a sound tank, it is evident that brickwork and masonry can be applied with like success. With these, each brick or stone will be required to be embedded in the cement, and to ensure the proper cohesion, it cannot be repeated too often, both should be saturated at the time of working.

I have attempted to explain the extraordinary strength of Portland cement, and to prove that tanks can be constructed without the aid of puddle, and, indeed, in most places on the Continent that material is not known, and, of course, is not adopted; yet, sound tanks of brick and masonry are to be found in abundance. Puddle was employed in the earliest years of gas lighting, long before Portland cement was discovered; and it would not be creditable to the present generation if they persisted in following the methods introduced fifty years ago, and particularly when such vast advantages are gained, on the score of economy. by the introduction of a more perfect and scientific mode of constructing gasholder-tanks.

[To be continued.]

Naphtha—An Explosion of the New Lighting Material.

ITS UNPLEASANT INTRODUCTION INTO THE OLD BROOKLYN HOUSE—THREE PERSONS SEVERELY BURNED.

The old Brooklyn House, located at the junction of Hamilton avenue and Union street, around which cluster many tragic and exciting reminiscences, was, last evening, the scene of an explosion of naphtha with which material Mr. J. B. Fuller, the new proprietor, was preparing to illuminate the premises. He had listened to flattering stories in reference to the advantages of naphtha, pecuniary and otherwise, over gas, and he made a contract with a New York firm to fit up a retort in the cellar for the manufacture of the new gas. For several weeks he had been busily engaged in renovating the old house, his intentions being to give the citizens of South Brooklyn all the advantages of a first class hotel. It only required the introduction of the naphtha into the various rooms of which there are over one hundred in the house to make the establishment in every respect ready for the reception of guests. Last evening a barrel of the naphtha was placed on the sidewalk and a wooden slide having been fitted up, communicating with the retort in the cellar, the stuff was taken from the barrel and allowed to flow along the slide into the retort. Two men, named S. B. Guion and John Winters, gas fitters, residing at No. 22 Rutgers street, New York, were looking after the work, while Mr. Fuller was close behind them, an interested spectator of the operations. The cellar being dark, a kerosene lamp on which there was no chimney, was called into requisition and was held quite close to the slide along which the naphtha was flowing. Suddenly the fumes from the naphtha came in contact with the flame from the lamp, and immediately an explosion took place and the entire cellar seemed to be in a blaze, as if a train of gunpowder had been touched off. Mr. Fuller and the two workmen, all of whom were more or less burned, rushed panic-stricken from the cellar, and for a few moments the occupants of the house, believing the place to be on fire, were thrown into a great state of alarm and began to beat a hasty retreat. Meanwhile the firemen from No. 3 Engine, only a few blocks distant, had promptly responded to the alarm, and the fire was extinguished with trifling damage. Mr. Fuller was severely damaged about the head and arms, but had vigor enough left to protest in most emphatic terms against naphtha, and to denounce those who induced him to locate it in the Brooklyn House. While he was in the doctor's hands he gave his men positive instructions to tear up the naphtha fixtures, root and branch, from every part of his premises. The other two men were attended by Dr. Crowley, of No. 99 President street, and Ambulance Surgeon Cochran. and were removed to the Long Island College Hospital. Their injuries, although painful, are not considered dangerous. The accident occasioned much excitement in the neighborhood, but Acting Captain Henry Kellett of the Third Precinct, was early on the scene with his reserves and preserved good order.—*Brooklyn Eagle.*

A Rare Opening.

A local contemporary says: "In answer to the following advertisement, I understand a good many applications have been received:

——— GAS COMPANY.

The Company are in WANT of a competent PERSON as Secretary. He must thoroughly understand the keeping of accounts, and will be required to inspect the whole of the consumers' meters (a scattered district) at least once a quarter, to collect all accounts, and generally superintend the management, making and distributing of about ten million cubic feet per annum. Application by letter only, enclosing testimonials, etc.

The following is a copy of one: "Sir: I beg to offer my services for the situation vacant at your gas works. I have just returned from Chicago, where, at the gas works there I was Chairman of Directors, Gas Engineer, Chief Secretary, Head Book-keeper, Cashier, Collector of Accounts, Inspector of Meters and Chief Stoker. I found, however, that I was not quite equal to laying all the mains and repairing the meters, as the company wished, so we parted. But I guess as your gas system ain't quite so large as that of Chicago, I might be able to throw in your gas mains and repair your meters, to the bargain. I have an iron constitution, with a character and intellect to match. You appear to offer no salary, but as it would be a waste of time to draw a salary, and might distract my attention from the duties of the situation, I will forbear mentioning that little matter, and as my clothes are all made without pockets, I think I am just the man to suit you. The nature of my qualifications are such that I am a whole gas works rolled up in one individual. You will thereby perceive the propriety of me writing my own testimonials, which I assure you are perfectly genuine. You say you have ten million cubic feet of accounts to make, distribute and collect per annum. Well, although we never reckoned our accounts in America by the cubic foot, I'll engage to do it against any Britisher in these parts, and work a spell at moon-raking occasionally besides. Yours, etc.,

PERPETUAL JACK, Vulcan Villa.'"

—*Journal of Gas Lighting.*

Gas Explosion.

At an early hour this morning (July 25th), an explosion occurred on board the the lighter Shamrock, which is used in carrying oil, and lies at the foot of Sullivan street, Red Hook Point, Brooklyn. The fire was caused, it is supposed, from the leakage of gas from an oil tank. The boat was damaged to the extent of several hundred dollars.

There was no person on board the Shamrock at the time, and the origin of the explosion is a mystery. There is a canal boat, the Willie B. Wright, lying alongside the Shamrock, and the Captain of the former reported that a quantity of rope was stolen from his boat some time during the night. He is of the opinion that the thieves may have boarded the lighter, and while there struck a match, which may have caused the explosion. The police were unable to learn the names of the owners of the lighter.—*New York Telegram.*

Advantages of Unity of Management of Gas Companies.

Could the Directors of the London Companies who have visited Paris, have had sufficient time to give a full and fair consideration to the circumstances of the Paris Company, they must have left the French metropolis with a strong conviction of the advantages of unity of management, or say, of amalgamation. The ten manufacturing stations of the company are all governed by the same Board, and a study of the accounts will reveal the economy which results from a concentration of management. More than this, we believe that the working details of each separate establishment will illustrate the good effect of supervision by one head. The managers of the various stations are a superior class of men, under the direction of one of the ablest Engineers in France, they must necessarily work to greater advantage than they would if each one carried out his own ideas. Still the managers are not at all fettered in their efforts to introduce improvements which may suggest themselves to their minds, and we owe to some of them many advances in our manufacture; but all is done under the control of a General Board, among whom may be found some men of great eminence in the scientific world. The advantage of having one body to carry out the business details will be apparent to every one. If we look at coal contracts alone, it is certain that a great saving must result from purchasing the raw material for all the stations at the same time. As the Paris Company work up their own residuals, we cannot say what would be the consequences if they made a single contract for the disposal of all these separately. One great advantage which will presently result from the amalgamations that have been carried out in this metropolis will, we expect, be a large profit from the working up of residuals. Supposing all the Metropolitan Companies united, a much larger field for manufacturing operations of this kind would be opened up, which, if well cultivated, must end in a large increase of profit to the united company.

With our complicated municipal arrangements, it would be difficult, under any circumstances, to introduce the plan which puts the municipality of Paris and the gas company in perfect accord, namely, the equal division of profits over ten per cent. We can easily imagine the delight which would be felt in Spring Gardens at the prospect of sharing in the profits of our companies. The sliding scale would never have been dreamed of, and the standard price might have been anything. It would be premature, however, to speculate upon contingencies which may never arise, and we shall not now attempt to indicate a course of policy which, while leaving the one gas company in possession of their property, would, at the same time, satisfy the wishes of our local authorities. They long for gas profits, and it may be possible to afford them the luxury without confiscation. Of Paris, the gas exhibition, and the arrangements of the Compagnie Parisienne du Gaz we shall presently have more to say, for the moment, we leave it with the suggestion that all metropolitan directors who visit Paris should study the admirable system pursued in that city, in which case we are certain they will come home fully convinced of the benefits of amalgamation.—*Journal of Gas Lighting.*

Gas Motors for Tramways.—The Lenoir gas-engine has been improved by Otto, with a view to its employment on street railways. It is stated, as the result of several comparative trials, that the Harding steam-engine effects a saving of from 10 to 25 per cent. over horse-power: Mevarsky's compressed-air engine, a saving of from 23 to 37 per cent.; and the Otto gas-engine, a saving of from 61 to 67 per cent. —*La Gaceta Industrial.*

Gas-Light Intelligence.

OUR EXCHANGES.

United States.

[*Engineering News.*]

GAS FOR WICHITA, KANSAS.—Wichita, Kansas, is talking gas works.

REDUCING THE PRICE OF GAS IN MILWAUKEE.—The Milwaukee Gas-Light Company has reduced the price of its product from $3 to $2.50 per 1000 feet.

GAS IN WATERLOO, IOWA.—Waterloo, Iowa, is to be lighted with gas. The work of putting down the mains and pipes has recently been pushed energetically, with a view to completion by to-day (Aug. 1).

GAS IN NEENAH, WIS.—The City Council of Neenah, Wis., has passed the gas ordinance, and Mr. J. D. Patton, of Hicksville, Ohio, will at once begin the erection of suitable buildings for the works and commence laying pipe. Ere winter sets in Neenah will be illuminated with gas.

[*From Coal Trade Journal.*]

GAS AT MONCTON, N. B.—At the recent annual meeting the report of the Directors for the year ending July 1st was read: "The report estimates the entire cost of the gas works and water works at $63,000. It states that a contract has been made with the Dominion Government for supplying the Intercolonial Railway works with gas and water, the company to receive $3000 a year for water, for the present, and $3.25 per thousand for gas, which the directors estimate, will yield another $3000 a year. The directors expect to receive $2000 a year from private parties in the town for gas, and $2000 from the town for water. They state they have arranged a loan with the Bank of Montreal for $36,000 (giving the note of the directors) to carry on the works, and that of the 30 per cent. call on the capital stock $15.000 has been paid in. They have contracted with Mr. Perry, of Montreal, for erecting the gas works, and the work is now in progress; with Mr. S. McManus, of Memramcook, for trenching, laying pipe and filling at 17 cts. a yard, and with Mr. D. O'Regan for delivering pipe along the line at 48 cents per ton. The report was received and votes of thanks passed to the Board.

PITTSBURGH GAS TROUBLES.—There is trouble in the gas business at Pittsburgh. At a recent meeting of the Gas Committee the bill for lighting certain districts by means of gasoline lamps, amounting to about $1,200, was approved, but the Comptroller has refused to certify a warrant therefor, on the ground that there is no appropriation to which the amount can be specifically charged. He says the appropriation ordinance gives certain specific amounts to the East End, South Side, and West End gas companies. These companies failed to come to terms with the city, and the Maloney Gasoline Company secured the contract for lighting the lamps in the districts covered by those companies, the terms being about $15.50 per lamp, where the gas companies charged above $40. This obstacle, the Comptroller says, will be removed if Councils will transfer the money now in the appropriations for the several gas companies named in the Contingent Fund for the payment of the bills of the Gasoline Company. This economical measure will probably be adopted at the next regular meeting in September.

[*From Iron Age.*]

GAS AND WATER TIGHT CLOTH.—Dr. Hirzel, of Leipzig, has recently patented in Germany, gas and water tight cloth, which he makes by placing a large, smooth piece of so-called gutta-percha paper between two pieces of some not too coarse and dense material —*e. g.*, shirting (undressed)—and then passing the arrangement between heated rollers. The outer pieces of shirting combine in the most intimate way with the inclosed gutta-percha to form a material which is impenetrable by gas and water. It may be made still denser and more resistant by being coated on both sides with, *e. g.*, copal lac. The substance is conveniently flexible, and will remain proof against variable influences of weather and external temperature. It can be applied to all those purposes for which water-proof material is used, and it is well adapted to form gas-tight membranes for regulators of pressure of compressed gas bags or sacks for dry gas meters, as also dry gas reservoirs.

Dangerous "Gas" Machines.

Not a month goes by but what we do not hear of some explosion and fire caused by so-called "gas-machines." Within the last few days the daily papers have chronicled the death of two or three persons, the injury of several others and the destruction of the town hall at Harrison, Ohio, by one of these machines; and we desire to enter our earnest and solemn protest against the danger to life, limb and property, caused by the use of such infernal machines as are erected throughout the country as "modern conveniences."

We state most emphatically, and can prove beyond question, that these gasolene torpedoes are more dangerous than gun-powder or nitro-glycerine; that their presence in any building occupied or designed for occupancy, is in violation of all the laws of precaution or safety, and would not be tolerated by law or countenanced by underwriters. Their name is a misnomer and their presence and use a peril.

The lighter products of the petroleum distillation pass through the most minute crevices, are highly volatile, readily inflammable, fiercely combustible and mixed in certain proportions with an excess of common air, powerfully explosive. Being heavier than air, the insiduous and invisible vapors evolved from naphtha, gasolene, benzine, &c., at normal temperatures, do not early make their dangerous presence known to the sense of smell, they flow like water along the floor or the ground, all the while mingling by diffusion with the air above and before them in explosive proportions. The tiniest flash will ignite this gaseous magazine and explode it with a rending and damaging effect proportionate to its quantity and the strength of the surrounding walls. That particular property of these heavy yet penetrating vapors which should cause us to specially guard against the possibility of their introduction or entrance into any room —and more particularly a cellar—seems to be entirely ignored in many domestic matters; and, strange to say, this precaution is most recklessly disregarded where skilled attention is least likely to be paid and the damage done swiftest and most terrible when it takes place. The employment in the household of the light oils, flashing below 125° or even 110° F. should be forbidden by the most rigid enactment prevented by the strictest surveillance, and visited with the heaviest and the most summary punishment. In ordinary metal lamps such oils after burning an hour or so, heat beyond their flashing point and are likely to burst; while glass lamps are liable to break and cause heavy loss, shocking disfigurement, excruciating torture and even agonizing death. Even with the excellent safety lamps on the market, the servant girl of the period endangers her own life and that of her house mates by filling with light flashing oils in the presence of another light, while her peculiar *penchant* for starting the fire with this inflammable liquid, seems to be undiminished by the daily records of terrible burning and disfigurement from such cause.

But we concern ourselves here specially with the so-called "gas-machines"—including all devices for mechanically impregnating air with hydro-carbon vapors. The whole series of hydro-carbons, from the heaviest to the lightest, will yield by destructive distillation at high temperature, fixed inflammable gases of high illuminating quality and capable of large dilution with air, for convenience of distribution and burning. Such products are lighter than air, and consequently, even if they were mere vapors liable to change their condition with each variation of our fickle climate, would be less dangerous than those heavy fluids which escape detection by smell.

It is possible by employing material and workmanship much above the average at our disposal, to produce a vapor-making machine which shall impregnate common air with inflammable vapors to such an extent that the mixture shall be inflammable, and which machine shall, if well and carefully tended, and placed in a remote and separate safety valve (*not in a cellar*), produce at a low cost an illuminating mixture, open only to the objection—no slight one—that unlike ordinary illuminating gas also explosive when mixed with air in certain proportions), its presence in the rooms, if a tap be left unturned or a pipe chance to leak, is not detectable early enough to prevent possible danger.

The proper way to use liquid hydro-carbons for illumination is either to use a wick and lamp pure and simple, employing the heavy and safe liquids, drawing them by capillary attraction, and by the flame manufacturing inflammable gases as fast as wanted and faster—or to entirely break up either light or heavy oils by destructive distillation at a high temperature in a closed retort, thus forming light and safe fixed gases of greatly superior illuminating quality, which may be diluted with air, or with "water-gas" proper, caused by the destructive distillation of water.

Let it be laid down as a rule, never to be forgotten or deviated from—that the light hydro-carbons, under any circumstances or surroundings, in any degree safe, or in any way to be exempted from constant attention and careful handling; and that their presence in any occupied building other than by watchful and prudent persons, is dangerous in the highest degree, and should be a matter for domestic warning and legislative enactment.—*Water, Gas and Steam.*

Utilization of Heat and Other Natural Forces.

In a lecture recently delivered by Dr. Siemens on the Utilization of Heat and other Natural Forces, some very suggestive facts were stated. He showed, among other things, how heat can be made to do a greater amount of work than ever by electricity. One hundred horse-power of steam or water may be used, for instance, at a central or convenient place to drive dynamo-electric machines. The current there produced could, by pipes, be conducted to halls or factories and then converted into light or mechanical power. If light were required, the equivalent to 125,000 candles would be given at an expenditure of three and three-fourths hundredweights of coal instead of three and three-fourths tons. The amount of force which is lost to man from not utilizing the Falls of Niagara is enormous. Every hour 100,000,000 tons of water descend: there a height of 150 feet is equal to 16,800,000 horse-power. To pump that water back, estimating the consumption of coal at four pounds per horse-power per hour, would require 266,000,000 tons of coal a year, or a quantity equal to the total coal consumption of the world. Evidently the best means of employing the available forces for work have not yet been put into use, and the neglect of wind, water and tide power is surprising when the whole subject is considered.—*Iron Age.*

American Petroleum Exports.

The exports this year have been larger than for any year previous to 1877, the total exports in gallons from January 1 to May 11 having been for five years 1878, 76,623,253; 1877, 87,252,268; 1876, 72,024,491. 1875, 60,542,620; 1874, 71,176,609. Before 1874 the exports had never reached 60,000,000 for this period.

The distribution of the exports from the different ports is a matter of considerable interest, as it is now

supposed to be substantially regulated by the contract of the Standard Oil Company with the railroad companies. Last year, it will be remembered, the proportion exported from New York increased enormously, largely at the expense of Philadelphia. This was chiefly due to a contest between the Standard Oil Company and the Pennsylvania Railroad, by which the former, controlling most of the petroleum to be shipped, refused to send anything over that railroad. That conflict broke out just about a year ago and lasted six months. Thus the part of the years for which the above figures are given was uninfluenced by this contest: New York exported 71·3 per cent of the total both years; Philadelphia, 15·2 per cent last year and 13·8 per cent this; Baltimore 9·8 per cent last year and 13·4 per cent this. New York has never, or at least for several years, exported a larger proportion than this year; Philadelphia, on the other hand, has never exported a smaller proportion (28 per cent in 1876 and 17·2 in 1875); Baltimore, in spite of its increase, has not this year reached the proportion which it reached in 1876 (16·7 per cent). So far this year the reports show that 71·3 per cent of the whole has gone by way of New York, 13·9 by Philadelphia, 13·4 by Baltimore, and 1·4 by Boston.—*Scientific American.*

Inspection of Mines.

A deputation from the South Yorkshire and North Derbyshire Miners' Association was introduced to the Home Secretary on Thursday by Mr. Macdonald, M. P., for the purpose of submitting to his consideration complaints of the alleged inefficient inspection of collieries, whereby lives were endangered and lost. One of the deputation said that the working of the Act was impeded by colliery owners, who discouraged the publication of defects by miners, and even punished complaints with dismissal. Mr. Cross, in reply, said: In regard to the point of dismissal of workmen, because they make complaints, I can only suggest a law cannot be made to reach that, however much I may deprecate such a course of procedure. You say that the number of inspectors is insufficient, and that some of them have taken the view that they ought not to make an examination until they are called upon to do so, or until an accident has occured. I can only say with regard to that that it has been set aside by the instructions issued. So far as the questions of certificated managers and prosecutions against them are concerned, the view I take is that certificated managers of mines ought to stand in the same position as certificated masters of ships, against whom the Board of Trade constantly take proceedings for neglect of duty, and in two or three cases I have directed proceedings to be taken against certificated managers. Mr. Piggott has touched upon a question of serious importance—viz., that there should be no gunpowder used in mines. Upon this great difference of opinion exists amongst the inspectors. Mr. Winn has always held that blasting ought not to be allowed, and that is a growing feeling I believe. Then I am bound to say this to you, that undoubtedly there is considerable objection to doing away with blasting by the miners themselves. I do not want to say more than this—that if you want the blasting to be done away with you cannot adopt a better plan than to pass resolutions against it in places where it is being carried on. Whether rightly or wrongly, there is a strong impression abroad that the men were the first to object to a law which would abolish blasting in coal mines. I need hardly say, in regard to ventilation, how thoroughly I sympathise with the remarks made. As to the prosecutions, all I can say is that, so far as I am concerned, if ever there is a *prima facie* case made out, prosecution follows as a necessary consequence, and that being the rule of the office, it will not be departed from. It has also been said that although the men are allowed to make inspection for themselves the masters ought not to get any benefit from those inspections; that is to say, that if a man inspects to-day and to-morrow, then comes a sudden influx of gas, the master ought not to shield himself behind the inspection made by the man. The question is whether or not the master or manager has been guilty of neglect, and that is only a question of evidence. If the men when they went round found the mine to be badly ventilated, and reported the fact to the owner, the responsibility would lie with him. I did not think, as I have to make a statement upon the subject elsewhere, I need go further; but as you are assembled here, I would like to assure you that as far as I am able I will endeavor to prevent the recurrence of such lamentable accidents as those of which we have lately heard.—*Iron.*

A Short History of Petroleum.

The *Lumberman's Gazette* gives the following short history of petroleum:

"The production of petroleum as an article of trade dates from the 28th of August, 1859, when Col. Drake, in a well 69½ feet deep 'struck oil,' and coined a phrase that will last as long as the English language. From that beginning it has increased to an nual production of 14,500,000 barrels of crude oil. The first export was in 1861, of 27,000 baarels, valued at $1,000,000, and the export of petroleum in the year 1877 was, in round numbers, $62,000,000. The annual product of petroleum to-day—crude and refined—is greater in value than the entire production of iron, and is more than double that of the anthracite coal of the State of Pennsylvania, and exceeds the gold and silver product of the whole country. As an article of export it is fourth, and contests closely for the third rank. Our leading exports are relatively as follows: Cotton annually from $175,000,000 to $227,000,000; flour from $69,000,000 to $130,000,000; pork and its products (bacon, ham and lard) from $57,000,000 to £82,000,000, and petroleum from $43,000,000 to $62,000,000. The total report of petroleum from 1861 to and including 1877 (16 years) has been $442,698,968, custom house valuation. From the best sources of information there are at this time 10,000 oil wells producing and drilling, which, at a cost of $5000 per well, would make an investment of $50,000,000 in this branch of the business. Tankage now existing of a capacity of 6,000,000 barrels cost $2,000,000, and $7,000,000 has been invested in about two thousand miles of pipe lines connected with the wells. The entire investment for the existing oil production, including purchase money of territory, is something over $100,000,000, which amount cannot be lessened much, if any, for as wells cease to produce new ones have been constantly drilled to take their place."—*Scientific American.*

Crude Petroleum.—The New York Produce Exchange has passed a resolution to sell crude petroleum in barrels, at the rate of 6½ pounds to the United States gallon.

What Is a Ton or a Bushel?

The recent Legislature of Pennsylvania passed the following bill in reference to what constitutes a bushel or a ton of bituminous coal. Heretofore a bushel of coal was seventy pounds:

Section 1. *Be it enacted, &c.*, That from and after the passage of this act the standing weight of bituminous coal in this Commonwealth shall be 76 pounds to the bushel and two thousand pounds shall be one ton.

Section 2. If any person or persons engaged in the business of mining bituminous coal shall fix or establish any other number of pounds by agreement or contract to be a bushel of bituminous coal than is provided for in the first section of this act such person or persons shall be guilty of misdemeanor and upon conviction thereof shall be sentenced to pay a fine not less than five hundred and not exceeding one thousand dollars, and all penalties recovered under this act shall be paid into the treasury of the State.

Section 3. All acts or parts of acts inconsistent with this act are hereby repealed.

Prices of Gas Coal.

Waverly Youghiogheny	5.25	
Moore's "	5.50	
Shafton	5.35	
Despard Marion	5.15	
Newburgh Orrel	@	3.85 at Baltimore.
Murphy Run	5.25	
Chesapeake and Ohio Agency Coal	5.25	4.00 at Richmond.
Newcastle	3.75 @ 3.85	
Provincial	4.15 @ 4.50	
Cannelton Cannel	10.00	
Ince Hall	8.00	

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
24 Pine Street, New York City.
August 16, 1878

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	*Par.*	*Bid.*	*Asked.*
Gas. Co.'s of N. Y. City.				
Central, Westchester	466,000	50	—	80
Harlem	$1,850,000	50	70	75
Manhattan	4,000,000	50	185	190
Metropolitan	2,500,000	100	128	132
" Scrip	$1,000,000	...	100	103
Mutual	5,000,000	100	73	76
" Bonds, gold.	900.000	1000	—	105
Municipal	1,000,000	100	95	100
New York	4,000,000	100	90	95
Suburban, W'stch'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	140	145
Citizens	1,200,000	20	72	77
" Scrip	320,000	1000	95	97½
Peoples	2,000,000	10	20	30
" Bonds	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	—	65
Nassau	1,000,000	25	--	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	75	81
" Scrip		...	95	97
Kings Co	200,000	100	—	90
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	105	107
Chicago Gas Co., Ills			150	
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind.		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L. I.	25,000	100	...	—
Jersey City	386,000	20	150	155
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	70	80
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede St Louis Mo.	1,200,000	100	100	110
Long Branch		20	40	50
New Haven, Conn		25	160	—
Peoples, Jersey City		...	106	110
Peoples of Albany	650,000	100	10	17
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	51	52
" Bonds			106	—

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THE UNDERSIGNED ARE PREPARED TO EXECUTE ORDERS FOR

NEWCASTLE COAL (NEW PELTON),

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10,000 Cubic Feet of 16 1-2 Candle Gas---40 Bushels Coke.

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Plainfield, N. J.....	80,000	100	—	105
Perth Amboy		25	—	95
Rochester, N. Y.....		100	50	60
Woonsocket, R. I....	150,000	100	95	...
Halifax N. S.....	400,000	40	148	150
Hamilton, Ontario...	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			93	94
St. Louis, Missouri..	600,000	50	73	75
Stillwater, Minn.....	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens..	600,000	100	—	60
Toledo, Ohio.....			95	97
Washington, D. C...		20	230	240

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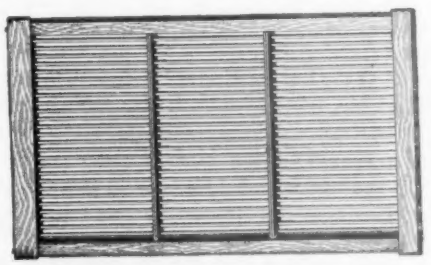

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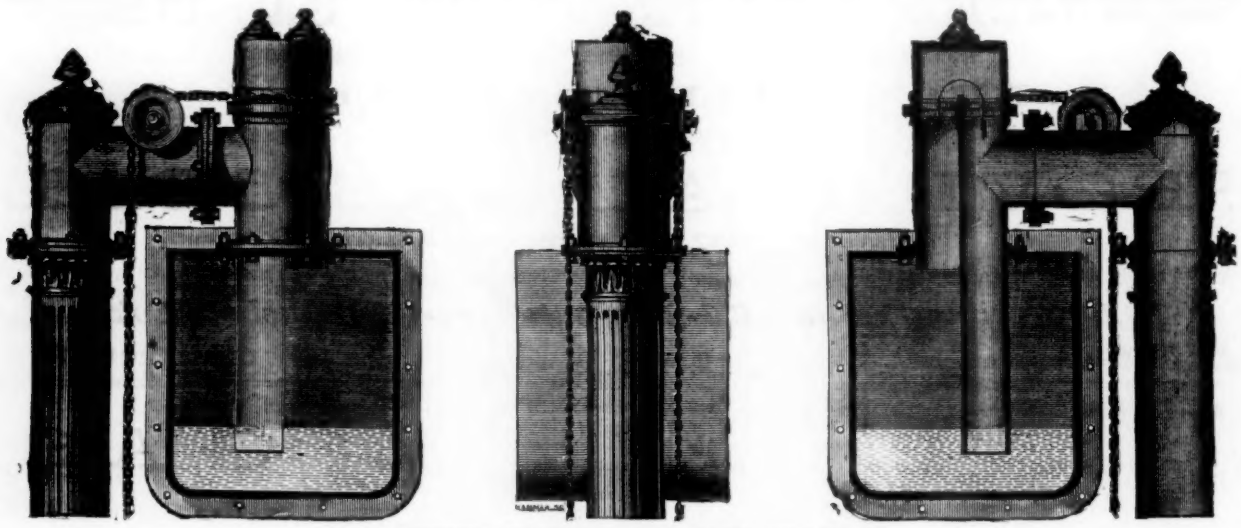

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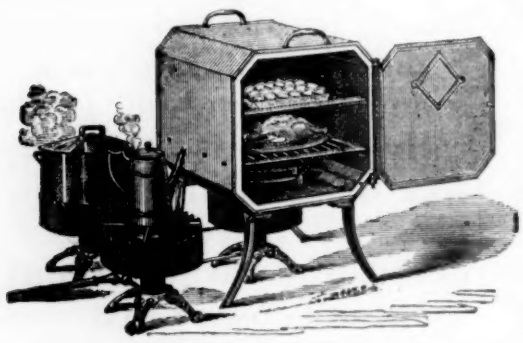

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351-1y

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Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

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The partnership heretofore existing between the undersigned, under the style of *PERKINS & JOB* is hereby discontinued by mutual consent.

Either partner is authorized to sign the name of the firm in liquidation.

NEW YORK, BOSTON. } Aug. 1st. 1878. JAMES D. PERKINS, DANIEL W. JOB.

The business of the late firm of *PERKINS & JOB*, in *NEW YORK*, will be continued by the under signed under the style of *PERKINS & CO.*

45 South Street, New York, Aug. 1st., 1878. } JAMES D. PERKINS, F. SEAVERNS, JR.

—oo—

The business of the late firm of *PERKINS & JOB*, in *BOSTON*, will be continued by the undersigned under the style of *DANIEL W. JOB & CO.*

91 State Street, Boston, August 1st, 1878. } DANIEL W. JOB.

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KANAWHA GAS COALS,

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From the Kanawha and New River Regions, on the Line of the Chesapeake and Ohio Railroads.

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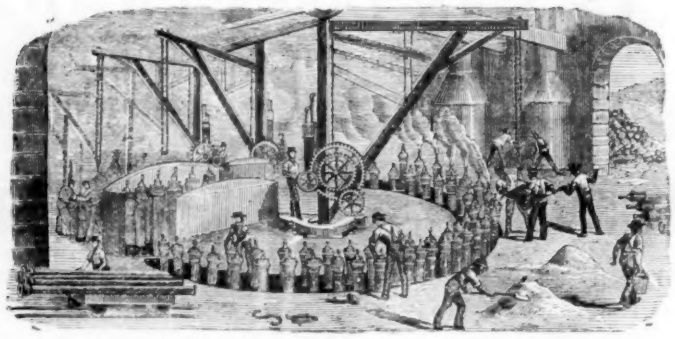

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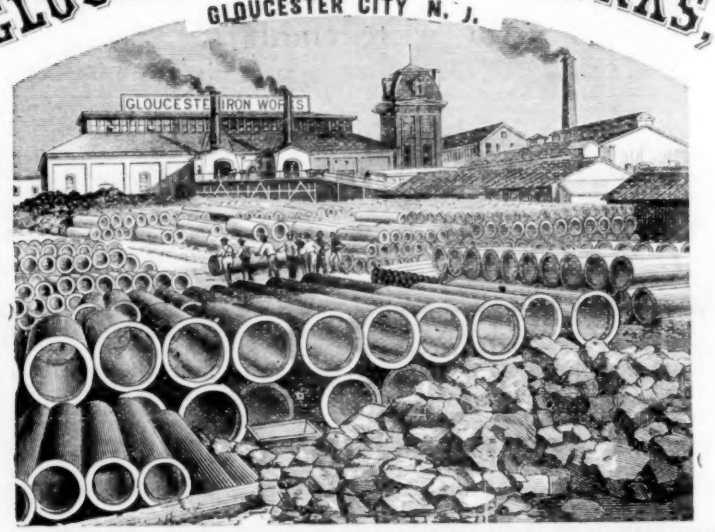

CastIron Gas & Water Pipes, Stop Valves, Fire Hydrants, Gas Holders. &c.

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FROM TWO TO FORTY-EIGHT INCHES DIAMETER.
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BRANCH CASTINGS, LAMP POSTS, Etc.

(Pipe from three inch and upwards cast *vertically* in 12 feet lengths.)

HEAVY AND LIGHT CASTINGS OF ALL KINDS.

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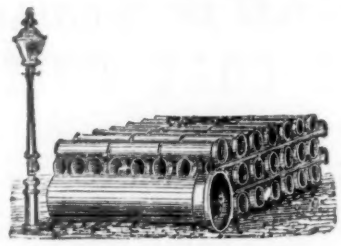

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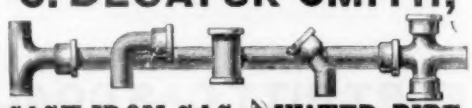

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from benches of one to six Retorts each.

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Pittston, Pa.	Buffalo, N. Y.
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Canton, Pa.	Little Falls, N. Y.
Annapolis, Md.	Penn Yann, N. Y
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Lynchburg, Va.	Gloucester, N. J.
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Zanesville, O.	Plainfield, N. J.
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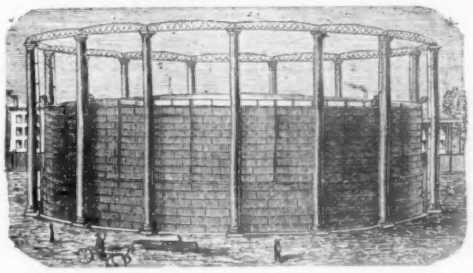

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Wrought Iron Lime Sieves

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With cast iron guide and suspension frames. GAS GOVERNORS or REGULATORS, STREET MAINS, from 1½ to 48 INCHES DIAMETER, for WATER or GAS. Street Main connections, such as BRANCHES, BENDS, DRIPS, SLEEVES, etc.

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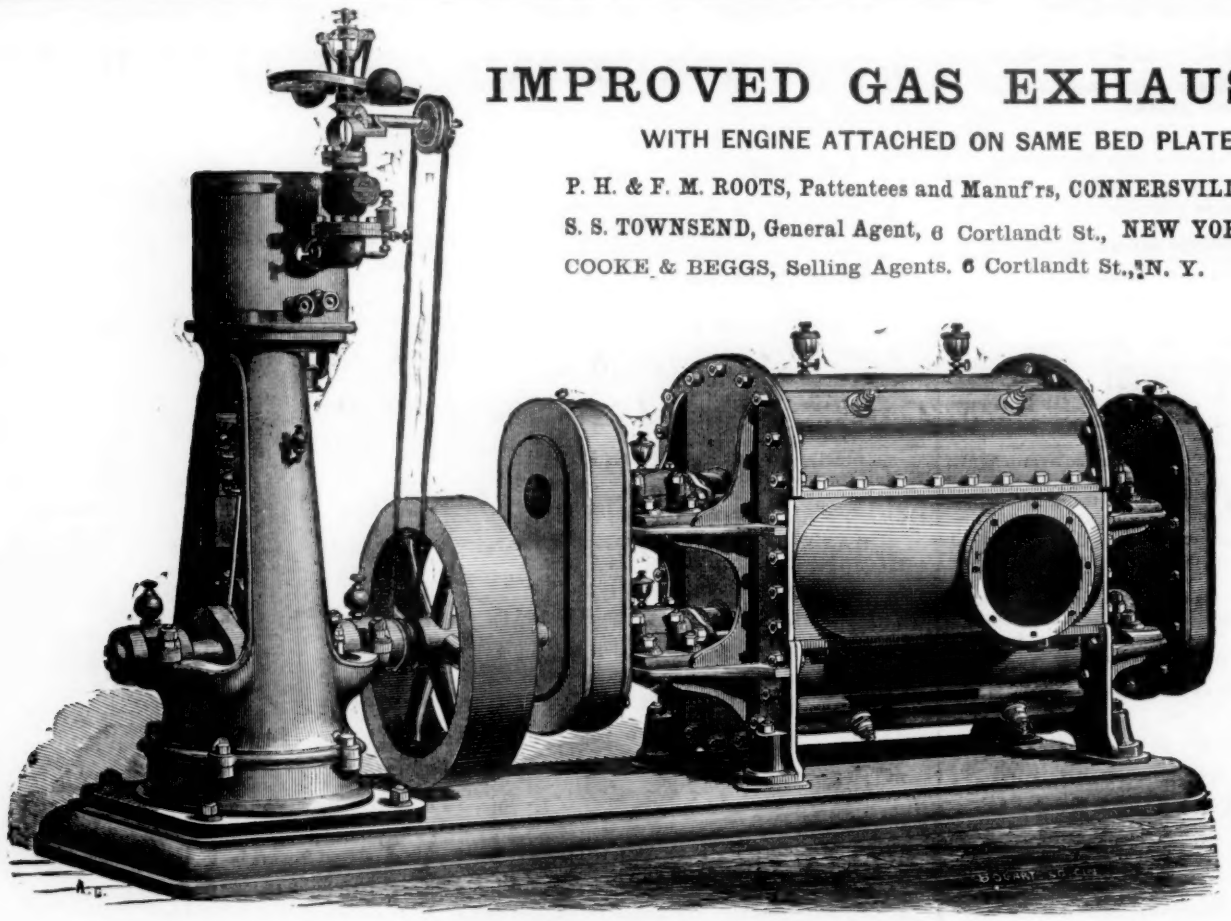

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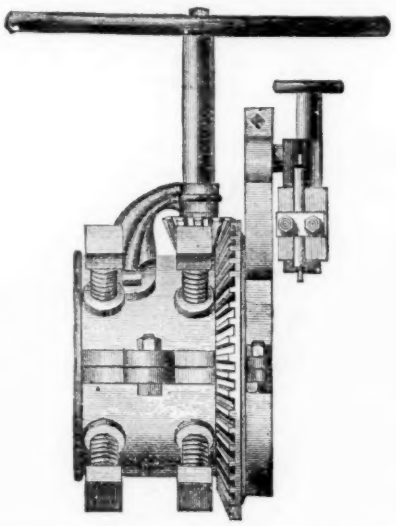

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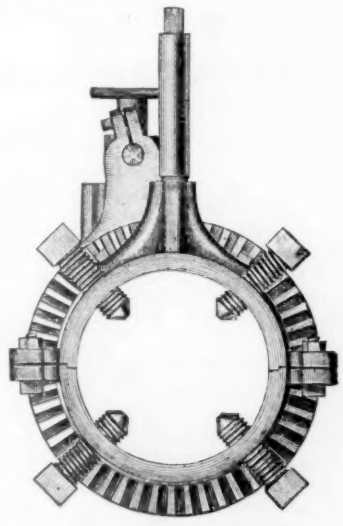

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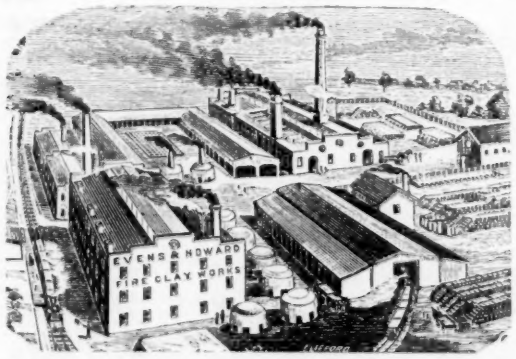

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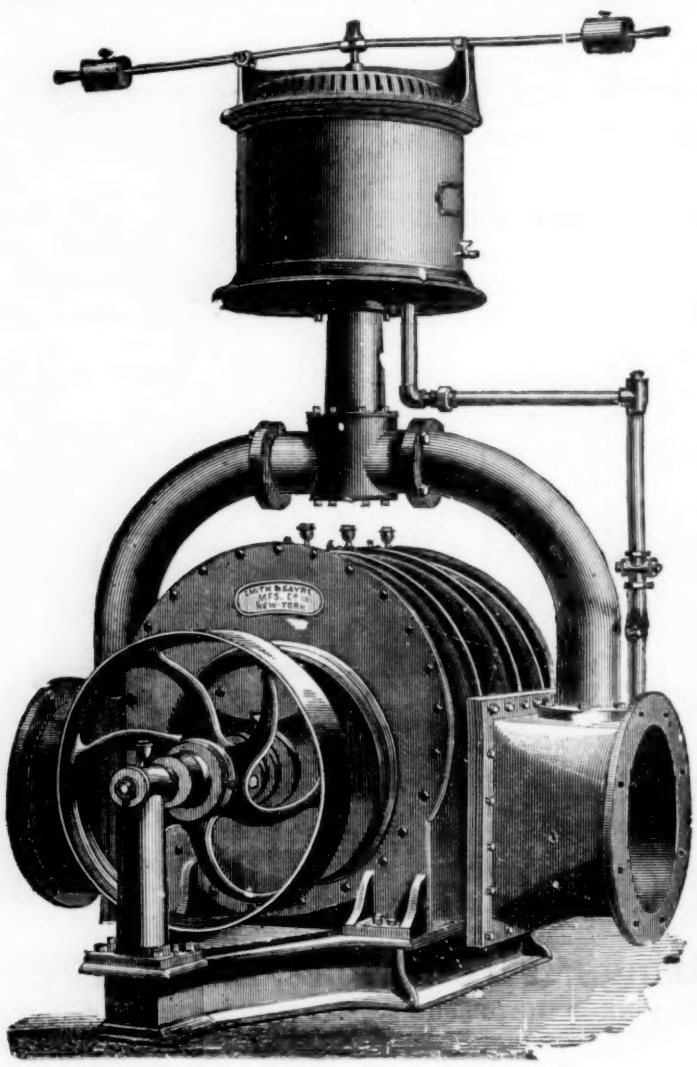

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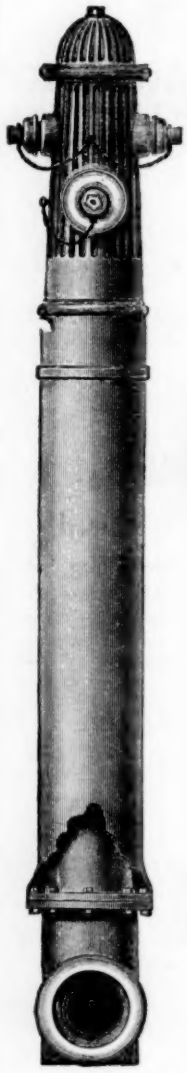

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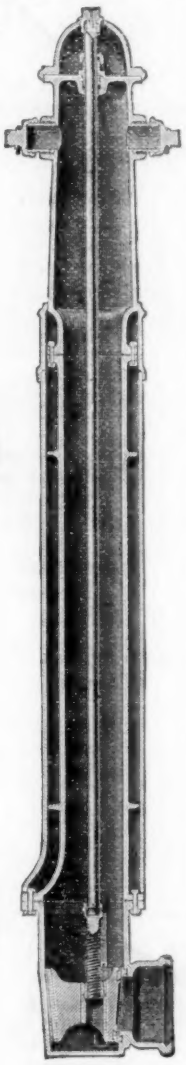

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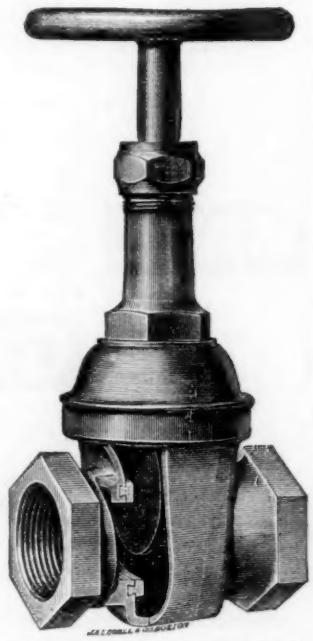

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